POPULAR SCIENCE

MONTHLY

JULY

NOW 15¢

See Page 37

NEW INVENTIONS · MECHANICS · MONEY MAKING IDEAS
HOME WORKSHOP PLANS AND HINTS · 350 PICTURES

The Service Representative in the telephone business office greets a young couple who want to have a telephone installed.

Good Neighbors

The Bell System serves the whole country, yet it remains close to the people. The people use it. Their savings built it. "It belongs to Main Street."

The 270,000 employees of the Bell System live and work in your neighborhood and in similar neighborhoods in every section of the country. They are good neighbors. Thousands of times each day and night their activities bring friendly aid to those in need.

To every one—to the newlyweds, to the man in the grand house on the hill or the little lady with the shawl—the Bell System offers the same full measure of service.

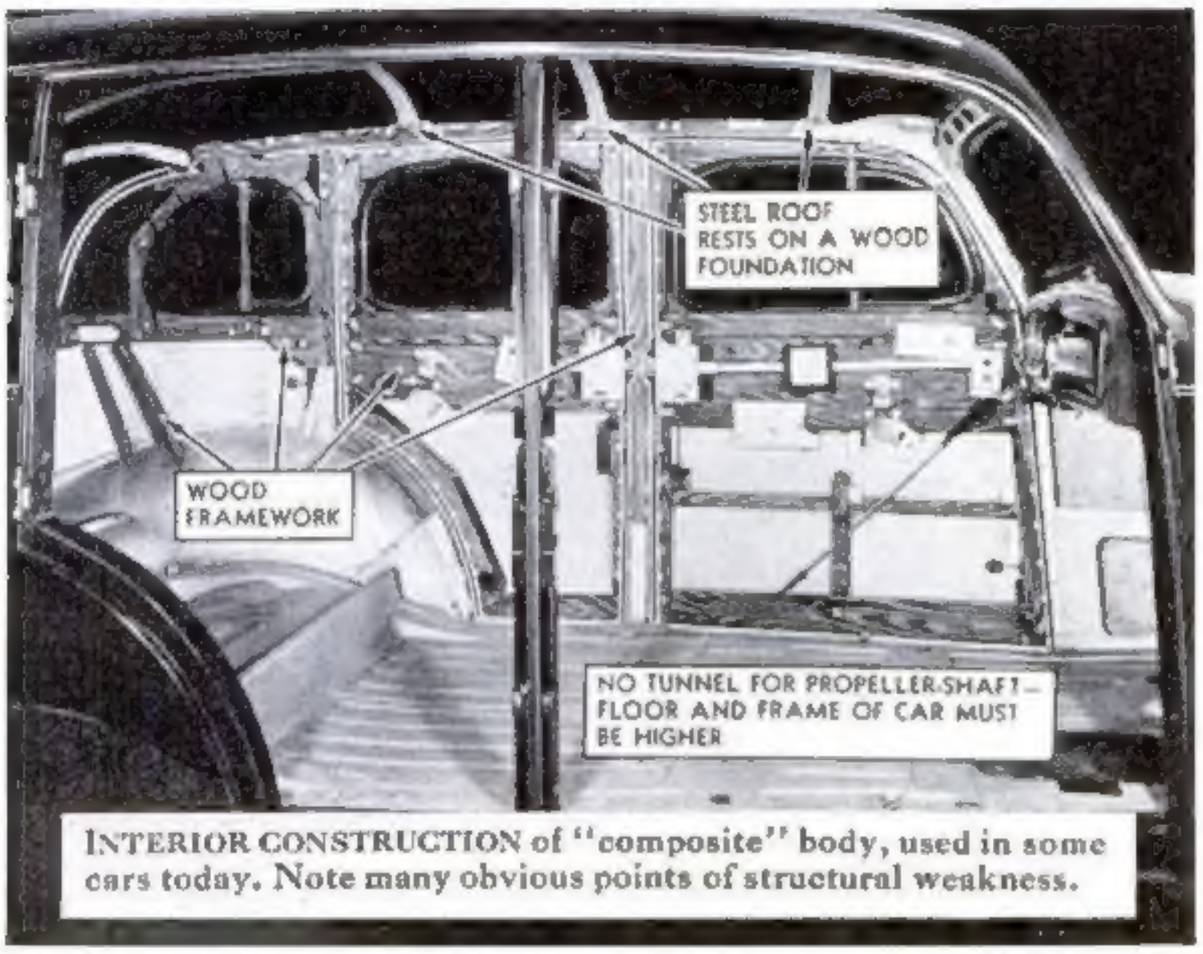
And seeks to do it always with courtesy and sympathetic understanding—in the manner of a friend.

BELL TELEPHONE SYSTEM

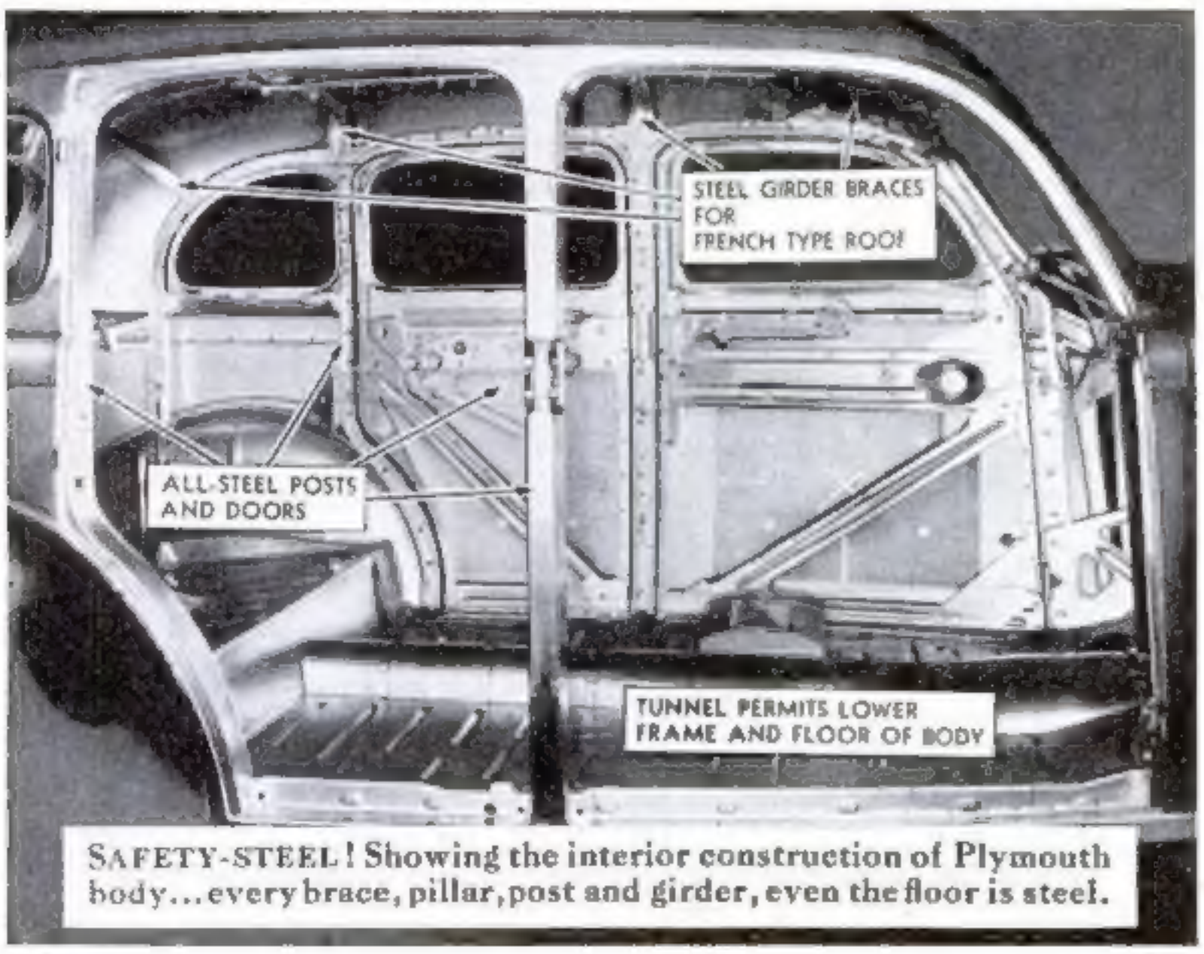
Steel *for Safety!*

BUT BE SURE IT IS STEEL

ACTUAL NEWS PHOTO of runaway freight car that toppled over on a Plymouth but couldn't crush in Plymouth's sturdy Safety-Steel body.



INTERIOR CONSTRUCTION of "composite" body, used in some cars today. Note many obvious points of structural weakness.



SAFETY-STEEL! Showing the interior construction of Plymouth body...every brace, pillar, post and girder, even the floor is steel.

(*Right*) HOW "COMPOSITE BODY" DOOR looks (left picture)... contrasted with all-steel construction of a Plymouth door (right picture). That Plymouth door doesn't loosen up... sag... or get the "rattles."

TUNE IN ED WYNN, GRAHAM McNAMEE AND ALL-STAR CAST, TUESDAY NIGHTS, N. B. C. RED NETWORK

Engineers Explain Safety-Steel Construction of Modern Automobile Bodies that Gives Most Protection

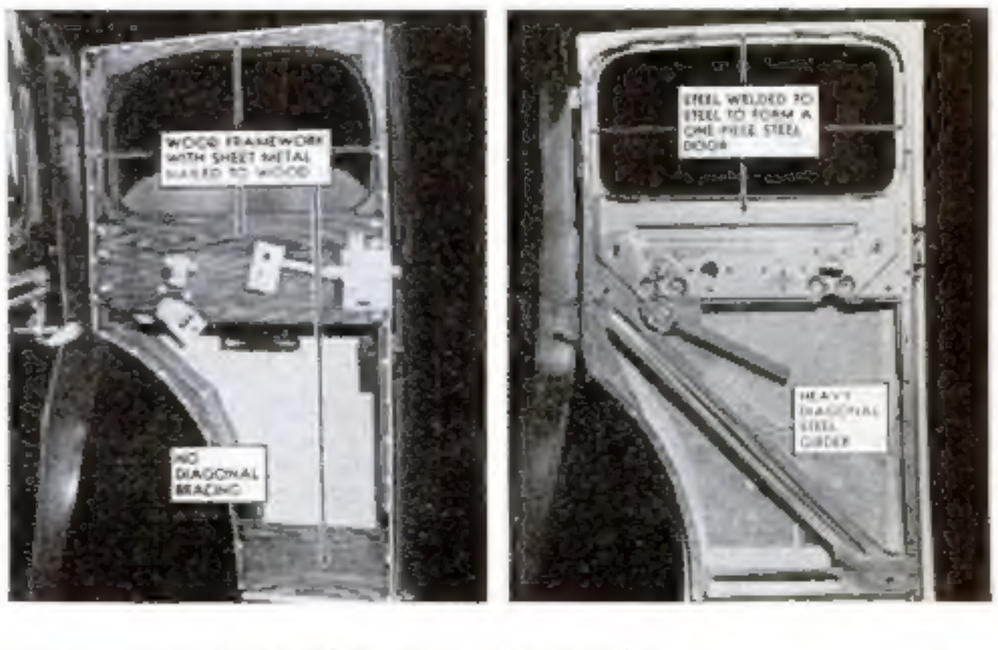
YOU MAY NEVER SEE the structural "inside" of your automobile body... a very important factor in motor car safety. These pictures show how the Safety-Steel body of the Plymouth gives maximum protection.

This beautiful Plymouth body is, structurally, all of steel. Steel posts, braces, panels, doors, window-frames... all are welded into one unit. Developed through years of experience... this body has many features of superior strength, durability and quietness.

Plymouth's body interlocks with the big car frame... is bolted to it both up-and-down and across ...giving tremendous strength and rigidity. This Safety-Steel body construction is the strongest, quietest, safest you can get.

Of "All Three" low-priced cars, only Plymouth has both Safety-Steel body and Hydraulic brakes. "Look at All Three" before you buy. Plymouth is priced with the lowest... only $510 and up, list at factory, Detroit. (Special equipment extra.) And it's EASY TO BUY... terms as low as $25 a month. Chrysler, Dodge and De Soto dealers.

PLYMOUTH DIVISION OF CHRYSLER CORPORATION



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FEATURES AND DEPARTMENTS

Cover Design by EDGAR F. WITTMACK

AUTOMOBILES

AVIATION

POPULAR SCIENCE MONTHLY FOR JULY, 1936

In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

Setting up the framing for a small house with "metal lumber." It can be sawed with a back saw and easily assembled with nails

NEW TOOLS AND MATERIALS FOR

Home Building *and* Repair

"METAL lumber" resembling ordinary "two-by-fours" is now making its appearance in small-home construction. Consisting of a composition core sheathed with metal, it can be sawed with an ordinary hack saw, fastened with nails, and easily assembled into framing right on the job. Because of its design, it is termiteproof as well as fireproof. In many new homes it is being used in conjunction with special lightweight steel floor beaming and precast fireproof composition floor slabs to provide miniature "skyscraper" construction.

SPRING CLIPS RENEW WORN ELECTRIC SOCKETS

WORN electric outlet sockets that no longer make good contact when a plug is inserted in them can be renewed easily with phosphur-bronze spring clips now on the market. No rewiring is necessary. The clips are simply slipped over the prongs of the plug, two projecting tabs holding them in place. They are equally effective for renewing worn plugs with loose or worn prongs.

Slipped over the prongs of an electric plug these spring clips insure perfect contact

HINGED WINDOW UNIT FOLDS IN FOR CLEANING

WITH a new-type window, both cleaning and ventilating are simplified. Arranged so they can be easily pulled inside the room, the double sash can be washed without once reaching outside or using a stepladder. They also provide an easy method of ventilation, since the lower sash can be tilted in to allow a good circulation of air without admitting rain or snow or creating a draft.

Questions

FROM HOME OWNERS

Q.—I WOULD like to know of a good finish for the pine-log side walls of my summer cabin. —F. E. K., Cascade, Idaho.

A.—ONE of the best finishes for peeled logs consists of three coats of boiled linseed oil applied warm. The first coat should contain twenty percent turpentine, the second ten percent, and third should be used unthinned. Allow two weeks between coats.

KEEPING PUTTY MOIST

K. D. G., CHICAGO, ILL. When putty dries too quickly and crumbles, the cause of the trouble generally can be traced to the fact that the dry wood of the window frame absorbed too much of the oil in the mixture. To prevent this, apply a coat of good quality house paint to the frame before placing the putty. A good durable putty can be made by mixing paste white lead with an equal weight of whiting and adding boiled linseed oil until the right consistency is obtained.

FILLER FOR FLOOR CRACKS

Q.—IS THERE any inexpensive mixture that I can make up for filling the cracks between the boards in an old wood floor?—H. L., Austin, Tex.

A.—IF THE gaps are not too wide, they can be filled with a mixture of sawdust and varnish. Wide cracks should be filled with strips of wood cut to fit and glued in place.

MENDING MARBLE SLABS

D. J. B., SEATTLE, WASH. Cracked marble slabs generally can be mended by cementing the pieces with an adhesive made up by mixing plaster of Paris with powdered gum arabic in the proportion of four parts to one by volume.

MEASUREMENTS FOR AWNINGS

T. P., PLATTSBURG, N. Y. Three dimensions should be given when ordering awnings—the outside width from one side of the frame to the other, the height of the awning exclusive of the scalloped edge, and the distance the awning should project from the house.

COATING WINDOW SCREENS

G. S. A., NEW HAVEN, CONN. Asphaltum varnish thinned with turpentine forms a good protective coating for galvanized window screening. Apply it with a close-grained sponge instead of a brush to avoid clogging the openings between the wires.

CLEANING A BRICK MANTLE

Q.—IS THERE any easy way to clean a brick mantle?—R. D., Minneapolis, Minn.

A.—A SOLUTION of one part muriatic acid in ten parts of water generally will do the trick. Work it into the stone with a stiff brush. Do not allow the acid to remain on the brick too long, however, and wash it off thoroughly.

TEMPERATURE FOR PAINTING

D. B., DENVER, COLO. A cold surface as well as grease or oil can cause paint to "crawl." If painting is done in cool weather, follow the sun around the house so that the surface will be warmed.

FOR STICKING DRAWERS

H. P., BOSTON, MASS. Drawers will slide more easily if a good coating of soapstone is rubbed into the bottom edges.

Melvin Purvis, former G-Man, employing the instrument used to determine the gun from which a bullet was fired

Our Readers Say

Reader Doesn't Get the Swing Of This Pendulum

THE article "Push-Button Museum Shows Secrets of Science" in a recent issue interested me considerably but I still don't understand how the Foucault pendulum demonstrates the rotation of the earth. It seems to me that the Foucault pendulum changes its line of motion because of air currents or other laws applying to a swinging pendulum. If the Foucault pendulum were affected by the rotation of the earth, wouldn't all grandfather's clocks come to a stop, and trains be derailed, and wouldn't we be dizzy all the time?—H.N., Lodi, N. J.

Would Get to the Bottom Of Well-Hole Astronomy

ONCE again, in the May issue, a reader claims to have seen stars in the daytime from the bottom of a deep pit. While science says that it is not so, the large number of eyewitnesses to the contrary suggests that there is some illusion or effect which convinces these people that they see stars. Some years ago, when this subject was under discussion, I thought of a possible answer which may interest many readers as well as H.M. VanD., of Lynn, Mass. The mineral mica is widely distributed as a constituent of rocks and soils. If a person descending into a shaft, well, or pit disturbs dust containing minute fragments of mica, the latter may be suspended in the air for a long time because of its light weight and relatively large surface. The observer looking up to the entrance sees twinkling lights as these minute flakes turn over and over in descent. These, I believe, are his "stars." It might take hours for a single flake to sink down a shaft of considerable depth. Finely powdered mica is employed in physics lectures to show the path of light beams in darkened rooms and the effect is striking. A fragment of mica would give a flash of light even though it were nearly microscopic in size. Has any astronomer ever seen a *constellation* under these conditions?—S.B.B., New York City, N.Y.

Brain-Wave Experiments Turn His Thoughts to Telepathy

AFTER being a subscriber to your magazine for a number of years, I would now like to have a word myself in your "brain-storm" department. The article "What Happens When You Think," in the May issue, was most interesting and I hope you will give us more like it. I believe such experimenting with the action of the brain will open the path to telepathy or thought transmission. Why can't messages be sent to the brain as well as from it?—C.E.M., Slater, S.C.

Antenna No Yardstick, This Reader Maintains

M.G., OF Brooklyn, N.Y., suggested in a recent issue that an area of a metallic object could be found by employing that object as a radio antenna. I do not believe there is any direct mathematical proportion between antenna area and speaker volume. It is quite true that, other conditions being equal, addition of more antenna brings an increase in volume, but it does not seem possible that any definite relationship could be worked out. Adding to the antenna length in units of twenty-five feet usually brings a volume increase up to 100 feet. From then on, the increase is uncertain. As regards the use of this method for measuring nonmetallic solids, I have never heard of any such solid which offered much of a path to high-frequency currents. I know that these currents are sometimes capricious, but they usually stick to the same conductors as their more docile relatives. —L.B.C., Crown Point, Ind.

Flash-Light Rifle Old Stuff, Says Tommy Atkins

I AM a British Tommy stationed in a very out-of-the-way place, but that does not mean that I am behind the times. I still manage to get your magazine which is posted to me by friends in America every month. In looking over some old issues, I am prompted to make a few remarks about items that have come to my attention. One short article told how a powerful flash light could be fixed under a rifle to be used in night hunting. In a following issue, I noticed a letter from a reader who claimed the idea was impractical. This idea is not only practical but very successful out here in India for big-game hunting. I have actually witnessed the shooting of mountain lions and tigers by a hunter using a rifle equipped in this manner. In another issue, a reader asked if anyone had ever seen a midnight rainbow. A number of my comrades and myself saw such a phenomenon a short time ago. It was caused by moonlight shining through a layer of moisture—confirmed the next day when we had one of our rare downfalls of rain.—A.B.T., Multan, India.

In This Case, the Plane Is Quicker Than the Ear

AS AN old reader of your magazine, I have seen problems come and go on the pages of Our Readers Say. Here's one that was suggested to me when I read about an Italian air school where they hope to attain a speed of 600 miles an hour. That is getting near the speed of sound. Suppose they develop planes that can travel as fast as sound waves; if you were near the line of flight of such a plane, what would you hear as it went by at full speed? The sound couldn't run ahead of the plane and reach you before it; and when the plane had passed you, it would be retreating at the speed of sound transmission, so that none of the noise could get back to you. Would the sound be laid down in stationary waves, or what?—G.T.M., Cambridge, Mass.

Nominates Colloids For Chemical Mystery Story

IN LAST month's issue the article "Life from the Test Tube," telling of research work in the field of proteins and amino acids was a timely one. As a sequel or companion subject, may I suggest the story of the latest developments in the field of colloidal chemistry. As all living substance is in a colloidal state, much more must be known about this peculiar molecular condition of matter before we can have life from the test tube. Some of the recent findings in this branch of chemical research, both with animate and inanimate matter, would be intensely interesting, I am sure. This work is vitally important to industry as well as to the science of medicine. Such an article, besides being instructive, would be as entertaining as a mystery thriller—W.A.L., St. Louis, Mo.

Partial to Instruments Of His Own Make

IN Our Readers Say I noticed a request for an article on telescope-mirror making for the amateur. I strongly support this idea and hope that in the near future you will publish such an article. Another thing, of all the articles that POPULAR SCIENCE has featured on microscopy not one has covered the construction of a microscope. I think such a suggestion would receive wide support. I have been reading your magazine for several years, and consider it to be the best in its field.—G.McK., Washington, D.C.

And Higher Voltages For Road Hogs?

IT SEEMS to me that you should run a page in your magazine for those readers who have ideas on how to improve the automobile. I know that hints for maintenance of the car are given as a regular feature, but no space is alloted for improvements. For example, such an idea as this: A pair of electrical contacts could be built into the speedometer which would flash a light on the instrument panel when the car dropped below a speed of twenty miles an hour or exceeded a speed of sixty miles—the limits being adjustable to any two speeds. Such an arrangement

would be useful in cities where maximum and minimum speed limits are in effect. In place of the light, a mild shock could be imparted to the driver, if desired, whenever a speed limit was broken.—A.G.S., Mercedes, Tex.

Why Lock the Stable Door, And Then Hand Out Keys?

YOUR article "Uncle Sam Cracks Down on Spies" set me thinking about the inconsistency of our whole system of guarding our military and naval secrets. We raise a great fuss if we catch a foreigner taking a picture of one of our harbors, even if the same view can be bought on a penny post card at the nearest drug store; and the generals and admirals get hot under the collar if an American magazine or newspaper so much as asks for permission to print a picture of some new military invention. At the same time, the embassies of all the foreign powers, including those that are generally considered to be potential or probable enemies, are filled with gentlemen known as military and naval attachés. Now, a military attaché is nothing more nor less than an invited spy; instead of having to sneak around in gum shoes and false whiskers, he is sent an engraved announcement when the new machine gun is being tried out, and walks past the guard while the newspaper men are getting the sharp end of the bayonet.—R.K., Spokane, Wash.

Improving Glass-Wool Filters With a Little Asbestos

I CAME across an article in the May issue headed "Spun-Glass Filters Resist Corrosive Liquids," in which it was stated that glass wool will serve as a suitable plug for filtering acids. This method can be improved by suspending shredded asbestos in water and then pouring the mixture over the wool plug until there is a half-inch layer of asbestos on the plug. Tamp this down with the finger and wash with water. If the filtered residue is to be analyzed, the topmost section of the asbestos layer is removed with a spatula and transferred to the proper receptacle.—L.O.B., Lambertville, N. J.

Steam Cars Are Not Extinct! He's Going To Buy One

YOU published a letter from a reader in the May issue who stated that steam cars are no longer manufactured. He was wrong, as there is a company in Massachusetts which still builds them. They burn gasoline, kerosene, or fuel oil and consume comparatively little water. As a matter of fact, I am thinking of buying one at the present time.—L.S.W., Macon, Ga.

Would-Be Decibel Hunter Wants a Noise Meter

KNOWING your willingness to help readers and to act upon suggestions from them whenever possible, I am offering a request for an article on the construction of an audiometer, the instrument that is used to measure the power of hearing or the audibility of sounds. Besides the knowledge gained in building such a set, there are, I am certain, a great number of people who would have a practical use for this type of instrument. I know in my own case it would be very valuable.—H.K., Vineland, N. J.

Now, We Feel Like Calling Her Mary, Queen of Scots

AS A Clydesider, and one who watched progress on the *Queen Mary* at Clydebank ever since the day her keel was laid, it makes my blood boil to read the writing of some American describing her as "England's mighty vessel." That is wholly untrue. She is Scotland's masterpiece and Scotland's alone. Clyde-built is her hall mark. Scottish craftsmen fashioned her from Scottish steel in a Scottish shipyard, the same yard that produced many other famous vessels—the *Aquitania*, the *Empress of Britain*, and a great many more. My plea is to give credit where credit is due. Any American would resent such ships as the *Manhattan* and the *Washington* being called Canadian ships when they're nothing of the kind. Likewise, we Scots will not have our product misbranded as the work of another country. Everybody ought to know by now that Scotland made the *Queen Mary*. New Yorkers will have a chance to see her lovely lines when she docks there at the end of her maiden voyage. —G.R.H., Glascow, Scotland.

Model-Plane Builder Wishes To Start Off Wright

FOR three years I have been a reader of your magazine and during this time I have made almost every airplane model designed by D. W. Clark. I would be grateful to you and Mr. Clark, if you would publish in some future issue detailed plans for the first Wright airplane, which made aviation history at Kitty Hawk, N. C. It seems to me that a model of this pioneer plane would be an important and welcome addition to every modeler's collection.—E.K., Pasadena, Calif.

Tell Us More, Says Farmer, About Crops for Industry

ON AND OFF, during the past few weeks, I've been reading about the wonderful things scientists have been doing with some of the products of our farms. One account stated that a well-known company was extracting a chemical called furfural from oat hulls and that the chemical was being used to make plastics, varnishes, shoe dyes, glues, and even a preparation that would keep flies away. Then another newspaper item told how they were going to take corn—this hits home for me—and distill it into enormous quantities of alcohol. Of course, that's been done for ages but this alcohol is not for people to drink. It's going to be water-free, so the article said, and will be blended with gasoline to make a cheaper and better automobile fuel. If they get the scheme working, it is predicted that 30,000,000 acres of corn will be used for this purpose. That, believe me, is a lot of corn. However, I know that scientists have fixed it so that a lot of American farmers are growing soy beans. A few years ago any farmer would think you were plumb crazy if you told him you were going to change to a crop of soy beans. But it's happened because they found something could be done with these beans besides eating them. So, I'm beginning to believe these other reports I read. What I'd like you to do is to line up these different goings-on into one story that I and my neighbors can understand.—F.J., Omaha, Nebr.

Again the Irresistible Force Meets the Immovable Body

BACK in the good old days, we learned that water reaches its greatest density at four degrees centigrade, expanding both above and below this temperature. Now, supposing a container were built which would withstand any stress without stretching or breaking, and that this container were completely filled with water at its greatest density and sealed. Would the water freeze or remain liquid no matter how low the temperature were lowered?—L.B.K., Cromwell, Minn.

One Eye Idles While The Other Sees Stars

A SHORT time ago while looking through a telescope I hit upon an idea which makes long observation with this instrument more satisfactory because it eliminates the necessity of squinting one eye. I made a viewing shield of black cardboard (black metal would be more permanent) shaped to accommodate both eyes and to fit on the eyepiece of the telescope. In use, the eye that is not observing is completely shielded and there is no inclination to close it, producing better and less tiring observation.—R.T., Ithaca, N. Y.

Suggests a Trip Into Field of Reflexes

AMONG your readers I am sure there are many who would appreciate an article on conditioned reflexes. Scientists have obtained interesting results in studying the reactions of man and some of the higher animals to unusual changes in their surroundings. A man becomes accustomed, quite apart from any instinct, to doing a certain thing in a certain way and finally develops what we call habits and traits of behavior. In other words, he learns to do many things quite unconsciously. Suddenly, he is prevented from doing some of these things he has been accustomed to and his attempts to meet the situation provide unexpected and sometimes surprising results. You should be able to put together a fine story on the subject.—A.K.B., Chicago, Ill.

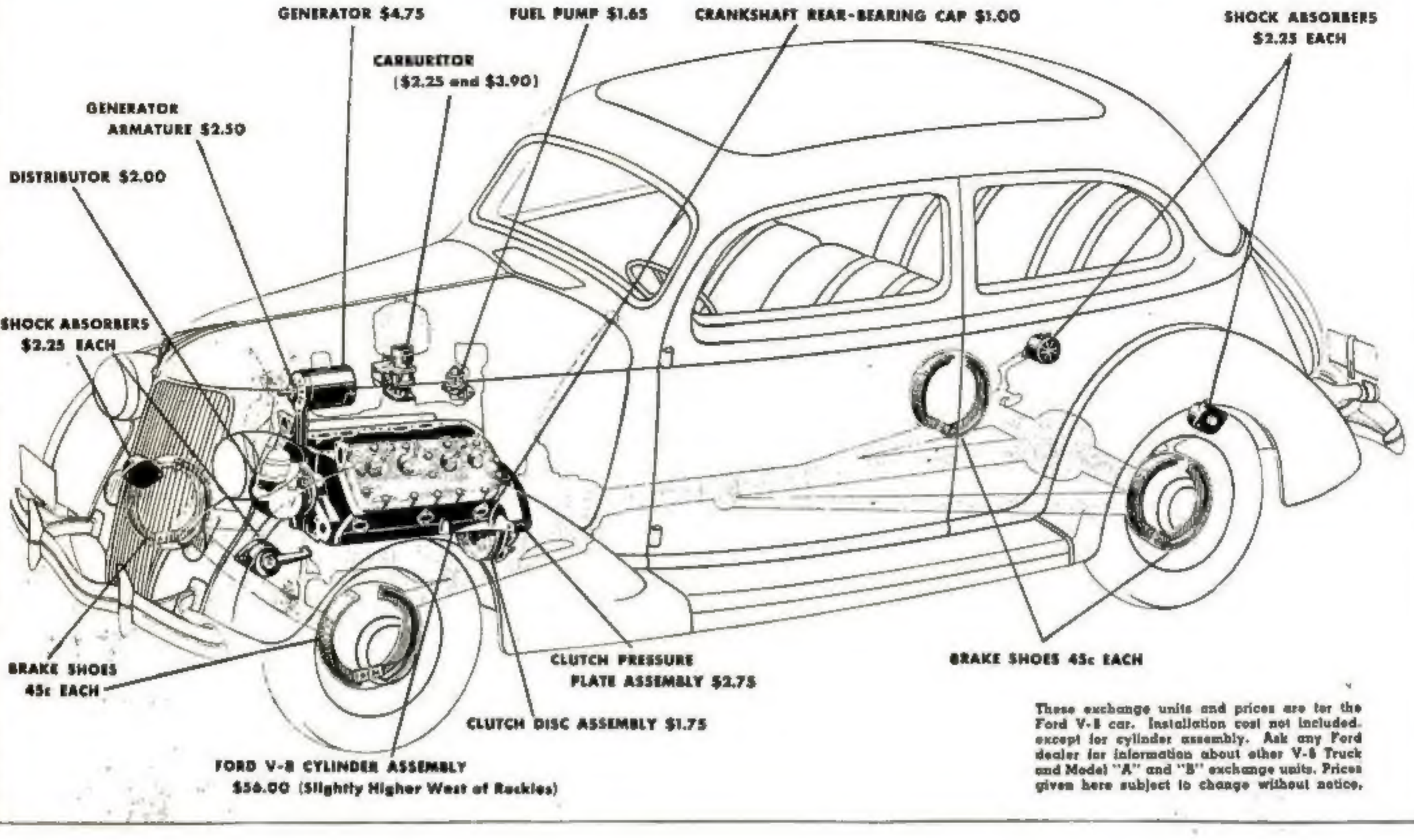
Looks Like These Mineralogists Held a Conference

SUMMER or winter my hobby is collecting minerals. During this time of the year, I drive off into different localities on week-ends searching for new specimens. In fact, there is quite a group of us doing the same thing. On one of these trips, we were talking about POPULAR SCIENCE MONTHLY and it was generally agreed that your magazine could give us a swell article on this subject. Will you do it?—M.L.H., New Haven, Conn.

His Ideal Car Would Have Carbon Monoxide To Burn

AUTOMOBILES are improved each year in many ways to provide greater comfort and convenience, but I think greater advances can be made in safety. One danger created by the automobile is that of carbon monoxide. Why not remove this gas, which is inflammable, from the car's exhaust fumes by installing a burner in the muffler or exhaust pipe to burn this gas and change it into harmless carbon dioxide? Provided with a self-lighting device and a draft to supply the necessary oxygen, I can't see why the arrangement would not be practical. In winter, it could serve an additional purpose as a car heater.—H.B.E., Scotia, N. Y.

FORD SERVICE EXCHANGE PLAN



These exchange units and prices are for the Ford V-8 car. Installation cost not included except for cylinder assembly. Ask any Ford dealer for information about other V-8 Truck and Model "A" and "B" exchange units. Prices given here subject to change without notice.

Only Ford Owners Enjoy the Economy of this Factory Service

THE complete overhaul of an engine, or the repairing of a unit, is usually a slow, difficult job for the local repair shop. It is an orderly, simple, efficient operation in the great River Rouge Plant of the Ford Motor Company.

The men who build your new engine rebuild the used ones. The Engine Exchange Plan gives you a shop-built . . . not a garage-built engine. Precision equipment guarantees certainty of result.

The Ford Engine and Parts Exchange Plan offers real advantages to Ford owners. It eliminates the old-fashioned, long-drawn-out and expensive overhaul and substitutes a factory-rebuilt unit which gives another long period of satisfactory service. The price of exchange units is much lower than the cost of new units. Factory standards of quality are assured. There is no waste of time.

Ford factory-reconditioned units, available through all Ford dealers, have helped thousands of motorists to keep their cars and trucks in first-class operating condition at very low cost. This exclusive service is one of the outstanding advantages of Ford ownership.

GENUINE Ford PARTS

F O R D M O T O R C O M P A N Y

POPULAR SCIENCE Monthly

JULY 1936 VOL. 129 No. 1

RAYMOND J. BROWN, *Editor*

Creating perfumes from fruits is one of the latest triumphs of chemical magic. Here Dr. A. T. Frascati is seen distilling fragrant essences from the products of California groves. From corn, chemists have made an innocent-looking sugar that can be changed to an explosive deadlier than nitroglycerin

NEW FEATS OF

Chemical Wizards *REMAKE THE WORLD WE LIVE IN*

By ALDEN P. ARMAGNAC

IMAGINE a ball of fiber, weighing only one pound, of so fine a texture that if unrolled it would reach from the Atlantic to the Pacific! This marvel of chemistry, exhibited when American chemists recently assembled at Kansas City, Mo., to compare their achievements, is the latest kind of rayon, or artificial silk. A garment made from it can be hidden in the palm of the hand. To produce it, laboratory workers have gone the silkworm one better—for it measures one third thinner than natural silk. Improvements in methods of purifying the wood pulp that serves as its raw material, and in the chemical solutions and machinery used in its manufacture, have combined to make its production possible.

As much like Arabian Nights tales read the stories of other feats that chemists here and abroad are accomplishing today. Your home, your clothing, your car, and the whole world about you are benefiting from the wizardry of their touch.

From water in which corn has been steeped during the manufacture of corn starch, they have found, comes a sugar with a strange dual personal-

THE SILKWORM IS OUTDONE

Fabrics made from a synthetic fiber that is one third thinner than natural silk. A one-pound ball of the gossamer yarn, some of which is seen beside the woman in the picture, would stretch across the continent

PLASTICS RIVAL WINDOW GLASS

Below, samples of a new transparent plastic material are being examined after a test to determine its resistance to weather. Because it is flexible, this material is replacing glass in the windows of airplanes

ity. In its pure form it is sweet to the taste, and is being tested clinically as a substitute for ordinary sugar in diets for diabetics. Treat it with nitric acid, however, and it becomes an explosive more powerful than nitroglycerin! It has the advantage that no inert material need be added to prepare it for use: nitroglycerin, a liquid, must be molded with earth to be usable in the form of dynamite, but the "corn dynamite" is naturally a solid. Applications are foreseen for it in quarrying, excavating, and tunneling. As much as 1,000,000 pounds of the sugar, it is estimated, can be recovered annually as a by-product of starch manufacture through a new chemical process devised by Prof. Edward Bartow, president of the American Chemical Society.

BY SEEKING a substitute for air, Dr. J. Willard Hershey of McPherson College, McPherson, Kans., demonstrates that the audacity of chemists knows no bounds. Recently he reported that he had found something better for human lungs than the natural atmosphere!

Air that we breath contains nitrogen, oxygen, and small amounts of helium and other rare gases. Would any other gaseous mixture support life as well? Shutting mice, guinea pigs, cats, and monkeys in hermetically sealed glass jars, Dr. Hershey experimented to see how long he could keep them alive in gases and gas mixtures of every possible variety, constantly supplied through tubes. Pure air, he found, came out second best in his tests! Animals thrived in a mixture of helium and oxygen, which received the highest rating. Sufferers from diseases which cause difficulty in breathing may be the first to benefit from his discovery.

Your motoring habits may be changed in two important particulars—tires and fuel—by new discoveries. Current reports from Germany announce that chemists there have mastered the production of artificial rubber—but American experimenters have already shown the way. A factory at Deep Water Point, N. J., is now producing synthetic rubber at the rate of a million pounds a year. Special properties give it important advantages over natural rubber in many applications, and in time of war, chemists foresee, it might replace the natural product altogether. For the discovery of its basic raw material—a compound of ordinary acetylene, named vinylacetylene—Father J. A. Nieuwland of the University of Notre Dame has received the Nichols Medal, one of the highest American honors in chemistry. "This field of research requires greater courage than that of the battlefield," declared the chemist who made the award. Experts well know the extreme danger of an explosion during experiments with little-known derivatives of acetylene, and Father Nieuwland, fully aware of his peril, risked his life countless times in the tests that led to his success.

MAKING gasoline from coal is an achievement of foreign chemists, and huge plants for the purpose have recently been set in operation in England and Germany. Meanwhile, in this country, the idea of blending gasoline with alcohol for motor fuel has aroused chemists to lively controversy.

Advocates of the plan maintain that it would enable farmers to dispose profitably of huge quantities of surplus farm products such as corn, which would be chemically converted into alcohol. Blending the product with a considerably larger proportion of gasoline, they assert, would yield a motor fuel at least as good as pure gasoline, if not actually superior in economy and power output. While chemists are not in agreement as to the value of the proposed blend, U. S. Bureau of Standards experts hold that it would be a satisfactory motor fuel with one important proviso—that, for best results, engines should be especially designed for its use. At any rate, motorists will soon have an opportunity to judge for themselves, for as this is written a plant is being opened at Atchison, Kans., to produce 10,000 gallons of alcohol from corn daily. The product is to be used to produce blended motor fuel, which is expected to sell at the same price as ordinary gasoline.

Photographers may benefit by an accident that recently befell four young research chemists, engaged in preparing a batch of photographic emulsion. To their surprise, printing paper coated with the emulsion produced black where the white parts of the picture should have been, and white where they expected black. Investigating, they found that they had stum-

A RARE METAL —PURE IRON

A ring of pure iron made by heating the metal in flames of hydrogen. Pure iron is rarer than gold, and will not rust in pure oxygen or water. Each light and dark area is a huge crystal

STRANGER THAN A FAIRY TALE IS THIS ACCOUNT OF THE AMAZING WAYS IN WHICH THE MAGICIANS OF THE LABORATORY ARE CREATING NEW MATERIALS TO SERVE THE COMMON, EVERYDAY NEEDS OF MAN

bled upon a formula for a new kind of material for photographers, which permits direct photographs to be made, without requiring the production of a negative as an intermediate step. The new emulsion is declared suitable for films, plates, or paper, and is developed by standard methods and solutions.

New metals are emerging from the laboratories of modern alchemists. Superior blades for safety razors are promised by a steel alloy developed especially for the purpose by chemists of the Mellon Institute of Industrial Research at Pittsburgh, Pa. Other combinations of metals have recently yielded a tungsten alloy that replaces lead as a shield against the powerful rays of radium; an alloy of iron, aluminum, nickel, and cobalt from which the most powerful permanent magnets in the world are now being made; and stainless-steel alloys, combining beauty with strength, for building railway cars. So bewildering is the variety of new alloys constantly being developed that chemists themselves are hard put to it to keep up with advances made by their own colleagues. To index what is known today about iron and steel alloys alone, in handy form for reference, the Engineering Foundation of New York City has put 150 men to work on a monumental search of the whole world's technical literature—an undertaking believed to be unprecedented in scientific history.

STRANGE as it may seem, one of the metals about which chemists know the least is iron itself! Pure iron is almost a myth. That the iron we know bears little resemblance to it, however, was demonstrated not long ago when experimenters produced the purest specimens on record, by heating them in hydrogen flames. The iron they obtained does not rust in pure oxygen and water, even after months of exposure.

Unfamiliar colors will greet the eye in the strange new world being created by scientific investigators. British chemists recently announced the discovery of a new blue coloring pigment, for use in paints and printing inks. Until now, ultramarine, discovered in 1704, and Prussian blue, discovered in 1826, have enjoyed a virtual monopoly for the production of this shade. Neither, however, has possessed all the qualities prized in a pigment—brightness, strength of coloring, and fastness to light and heat, as well as to acids, alkalies, and other solvents. The new pigment, christened "monastral fast blue," is hailed as satisfying every one of these tests. In addition, it is declared the nearest approach yet made to an ideal shade of blue for color printing.

A pump for dispensing gasoline produced from coal, installed at a filling station in London, England. European plants for distilling this fuel are in operation

Random examples like these show how the triumphs of chemists are affecting every branch of life. Some of the most remarkable transformations wrought by their magic, however, may occur right in your own home.

Wooden furniture, for instance, may become out of date before long. Things that have always been made of wood or metal—radio cabinets, bottle caps, bowling pins—are now being fashioned from synthetic materials known as plastics, created in the chemist's test tube. That, experts say, is only a beginning. Imagine tables, chairs, and beds made of these glistening plastics, easy to keep spotless and difficult to scratch or mar! At this very moment, only the slightly higher cost of the synthetic materials stands in the way of their universal use. If it can be pared down so that plastics can compete with wood and metal on a price basis—and this is quite within the realm of possibility, according to William Haynes, New York chemical expert—their possible applications become startling. "Just one industry I can find," another prominent chemist, Dr. John E. Teeple of New York, remarks jestingly, "where the disappearance of wood might be a horrible calamity. I cannot see how the manufacture of antique furniture could continue without wood!"

RUBBER MADE AT DINING TABLE

At left, guests at a luncheon for industrial executives are making synthetic rubber under the direction of Dr. J. C. Patrick, chemist. Above is a sample of the rubber produced. Synthetic rubber will make this country independent of all foreign sources

EVEN the supremacy of glass as a material for windows is threatened by new transparent materials of the plastic type. While their value for use in the home remains open to speculation, they have a number of desirable qualities. One is their flexibility, permitting them to be bent into curved shapes—a feature that has already led to their adoption for airplane windows.

Will steam heat go into the discard one of these days? Chemists are developing a preparation to take the place of steam in a heating system. *(Continued on page 109)*

CLIMBERS PREPARE FOR Latest Attack

Man Pits Skill and Endurance Against the Formidable Barriers With Which Nature Surrounds The Roof of the World

By GROVER C. MUELLER

A member of the Ruttledge party blowing into a lung-testing device to determine whether his lungs will be able to function in the thin air encountered at the top of Mt. Everest

STRUNG along a razor-edged ridge of rock that leads up to the 29,141-foot peak of Mt. Everest in the Himalayas, a series of tiny camps dots the path to the highest spot on earth. As this issue goes to press, a picked group of climbers is about to attempt once more the conquest of the world's loftiest mountain. At the first sign of favorable weather, two of the hardiest mountaineers will sally forth from the last outpost, 27,800 feet up, in a dash for the summit against almost overwhelming odds

Although airplanes have flown over the summit of Mt. Everest, four previous expeditions have failed in the effort to actually set foot upon the jagged pinnacle that marks the top of the world. Nine men have perished in the attempt. Mindful of the lessons of the past, expert climbers led by Hugh Ruttledge, British mountaineering ace, subjected themselves and their porters to last-minute physical examinations before the start of the grueling ascent.

Breathing into a device resembling a miniature bellows, they tested the ability of their lungs to function in the thin air. The expedition's doctor peered through his microscope at samples of their blood. Men, as well as luggage, went on the scales, and [illegible] overweight [illegible] [illegible] [illegible] glad

Unbreakable dishes being packed for the use of the expedition. At the right are some of the 250 Mongolian ponies that carried food and equipment to the base camp at the foot of the mountain Native porters are used in the actual climbing

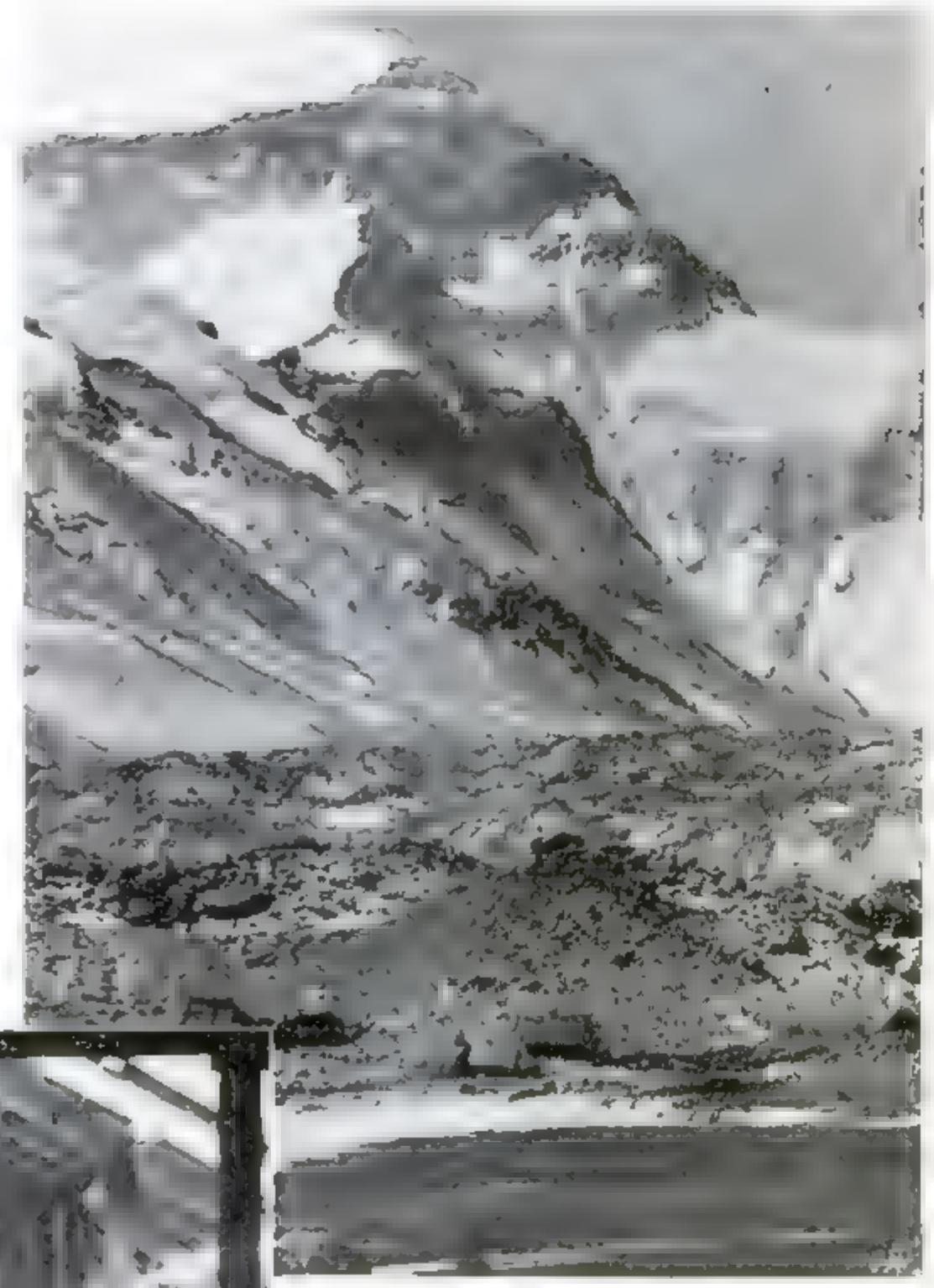
on Mt. Everest

be unable to keep up with the rest were eliminated. With preparations completed, the explorers set forth from their headquarters at the foot of the mountain to establish Camp No. 2, Camp No. 3, and succeeding bases at ever-increasing altitudes.

Shelter tents and supplies, at these way stations, enable the men to accustom themselves to the altitude and to prepare themselves for the perilous journey to the next higher camp. Beyond the last station lies the "hell stretch" that has defeated so many —the precipitous, awe-inspiring trail leading to the summit, where the final struggle must be made.

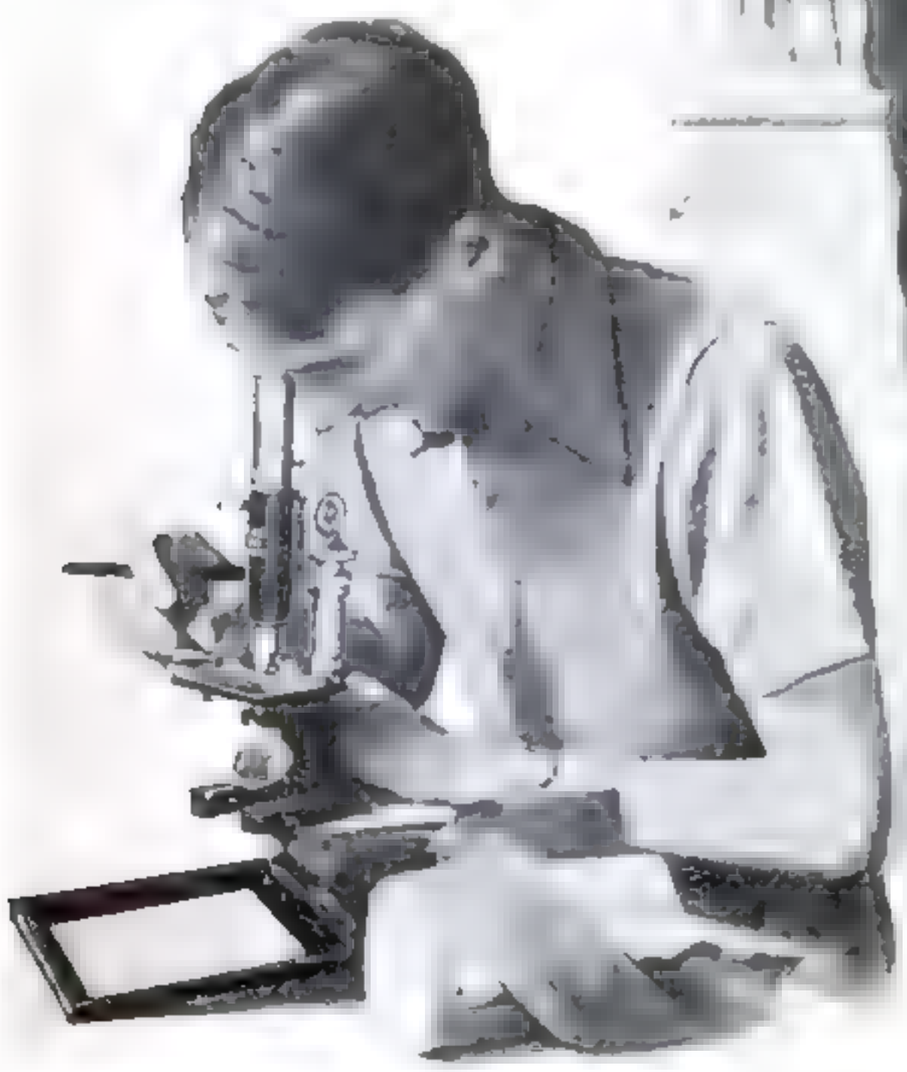
Here, the climbers must contend with a deficiency of oxygen that saps their physical strength and makes every step a heroic effort. Aviators consider it necessary to use an artificial supply of oxygen above an altitude of 15,000 feet. Mountain climbers, to whom each ounce of weight is so much added burden, usually prefer to rely on acclimatization and sheer stamina. Though the Everest party took along the latest of oxygen apparatus, whether they will use it is a question

Supplies enough to stock a department store went with the Ruttledge expedition. There are arctic-style tents, provided with double walls to keep out the cold, and streamline in shape so that gusts will not tear them from their moorings. Fur-lined boots and unbreakable dishes are important items. Cameras and color film will record the beauty of the majestic panoramas seen by the climbers. Besides the standard ropes, pegs, and ladders used by all mountain climbers, special lightweight pegs of duralumin alloy and six hundred feet of silk parachute cord, strong enough to support a weight of 800 pounds, have been provided for those who will make the final, desperate effort to reach earth's last remaining goal of adventure.



The unscaled peak of Everest
From a base camp at the foot of the mountain, the climbers have laid a chain of smaller camps to the 27,800-foot level, from which the final, desperate dash will be made

Dr. Warren, physician of the party is seen below making a microscopic examination of blood samples to determine the physical fitness of the native porters. The expedition's success depends largely upon these men



Lightweight oxygen-supply equipment designed for use by mountain climbers. The Ruttledge party is furnished with the latest apparatus of this type, though mountaineers are not agreed whether it is more of a help than a hindrance

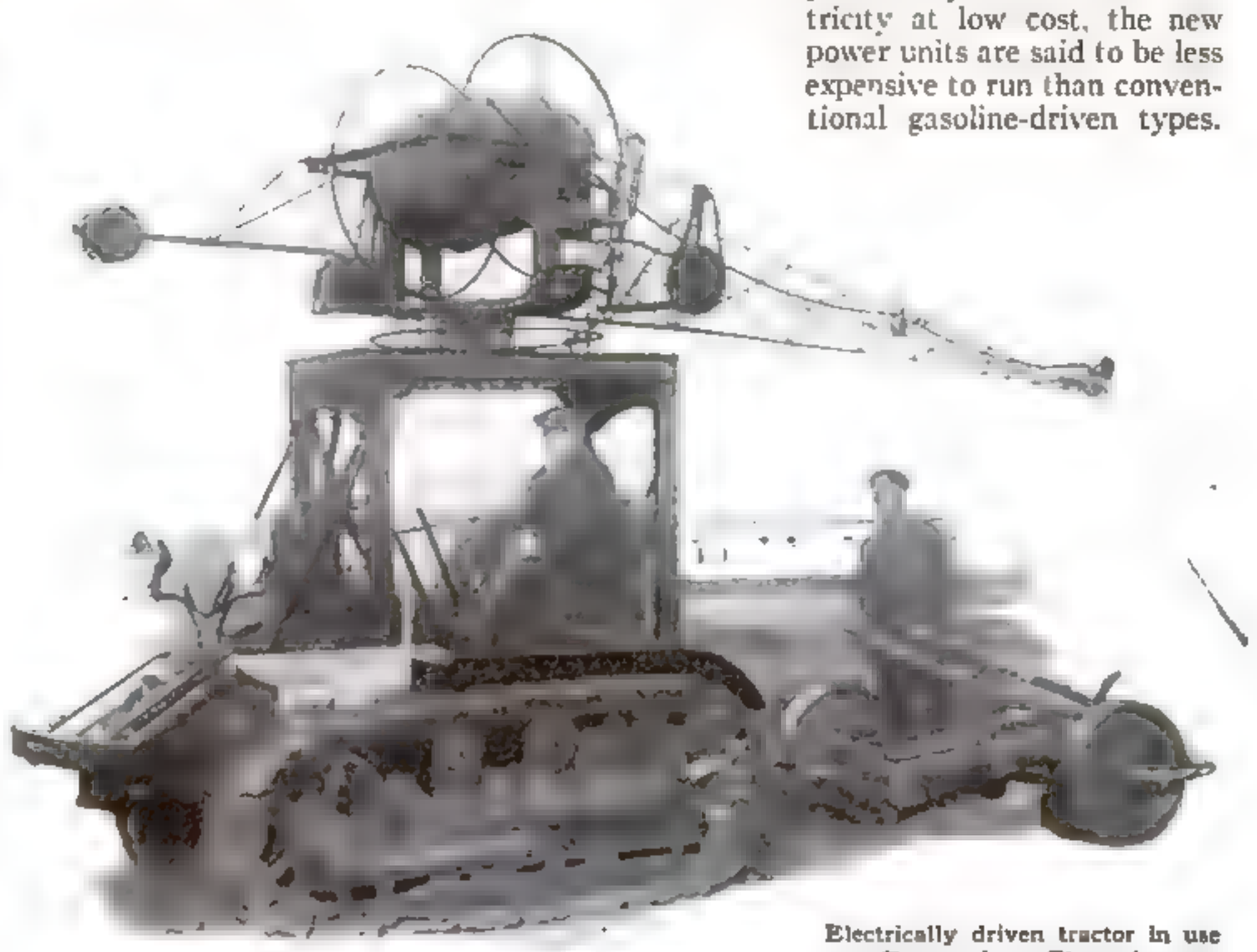
A porter "weighing in." Men as well as luggage, went on the scales, and those who proved to be overweight were eliminated. In the strenuous work ahead, excessive poundage would make it impossible for a man to keep up with the rest, and cause him to be a burden to his companions

BULL WITH SINGLE HORN IS MODERN UNICORN

WHAT might be called a modern unicorn has been produced by Dr. W. F. Dove, University of Maine biologist. From a day-old bull calf, Dr. Dove removed the two small knots of tissue which normally develop into horns. These horn buds he transplanted in the center of the bull's forehead, thereby inducing the growth of a single massive horn. The bull, now nearly three years old, has developed much of the proud bearing ascribed to the mythical unicorn.

CABLE ON REEL POWERS FARM TRACTOR

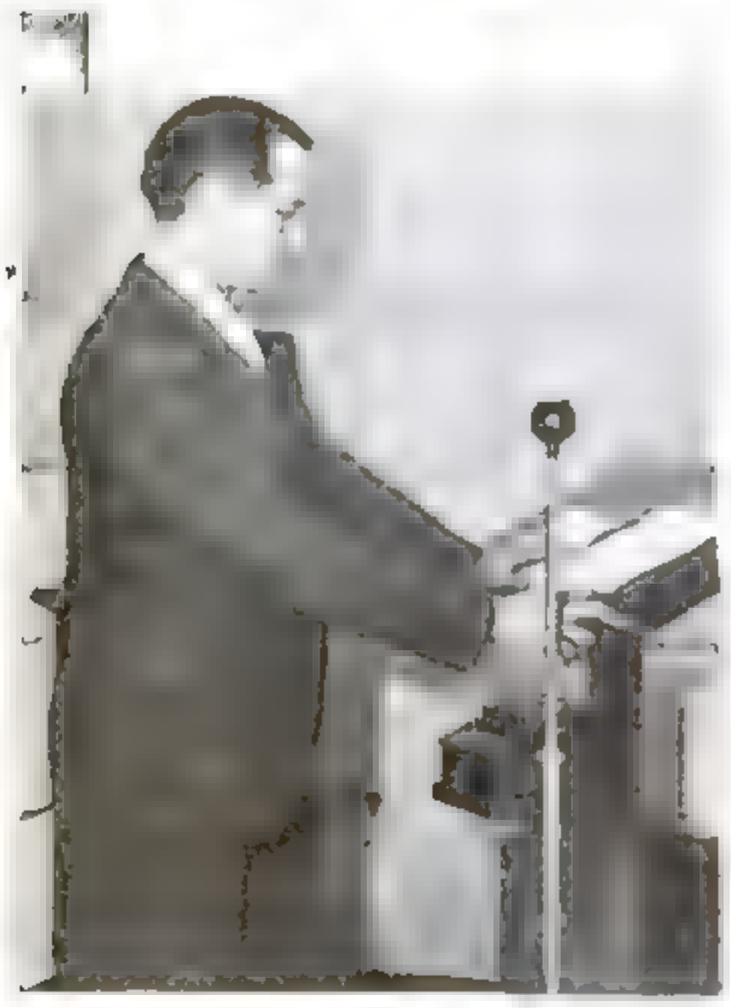
AN ELECTRIC motor drives a new type of endless-tread tractor developed for use in Russian agricultural districts. Electric current is supplied through a long power cable which is automatically paid out or rolled in by a spring-operated reel mounted on a turntable on top of the tractor driving cab. The cable runs along pulleys attached to a projecting arm so that it will not interfere with the harrow, plow, or other implement being towed by the tractor. The same principle has been applied to many other types of mobile agricultural machines. Because a widespread network of power stations supplies many farms with electricity at low cost, the new power units are said to be less expensive to run than conventional gasoline-driven types.



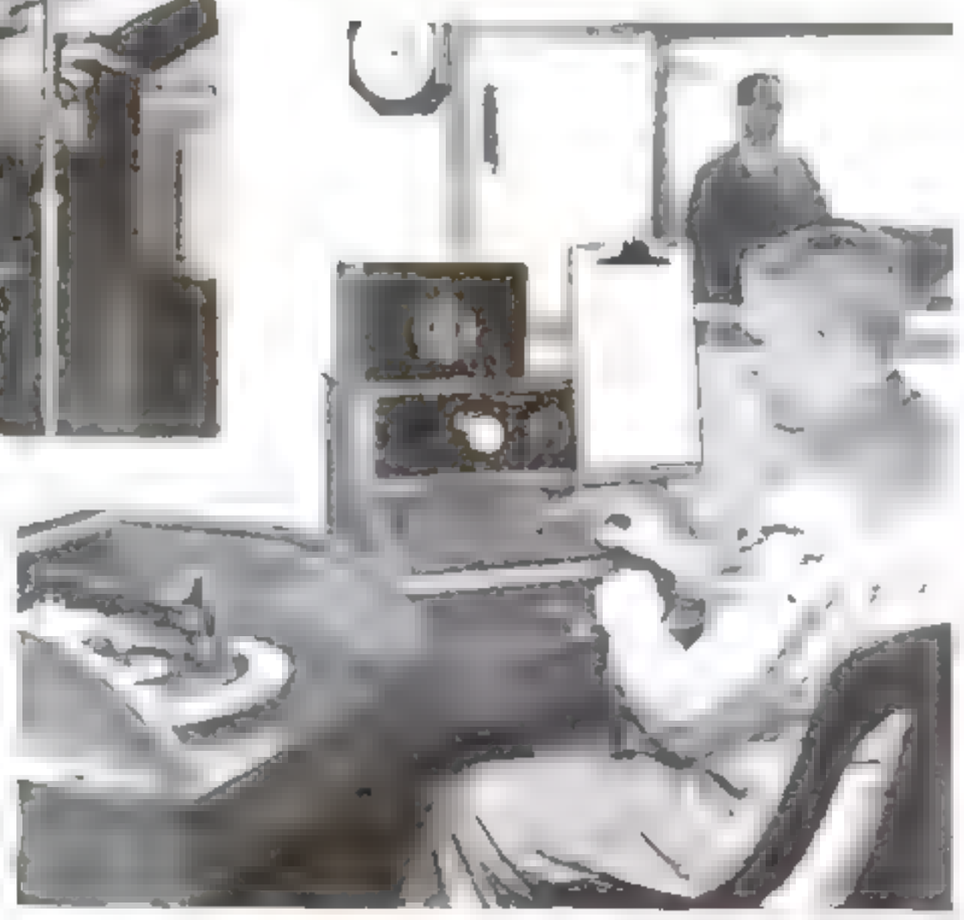
Electrically driven tractor in use on a Russian farm. The reel on top trails a cable to supply the power

GROCERY STORES GET MUSIC IN "WIRED-RADIO" PROGRAMS

HOUSEWIVES in New York City are now buying their groceries to the strains of concert orchestras, as the result of a recently inaugurated "wired-radio" service being offered to hotels, restaurants, and shops. Special musical programs, reproduced from high-grade recordings in a central studio, are transmitted by direct telephone lines to loudspeakers installed in fifty stores of a large grocery chain. Between musical numbers, a studio announcer calls the customers' attention to new food items, daily specials, and exceptional values being offered. If the main office of the grocery chain decides to reduce the price of a given item, the information is announced over the store loudspeakers and the change becomes effective at once. General "wired-radio" programs, without special announcements, are supplied to restaurants and hotels in the metropolitan district by four studios, each of which is equipped with dual phonograph turntables and operates twenty-four hours a day.



An announcer reading a sales message as part of a "wired-radio" program supplied to a large chain of stores. Note new-type microphone used

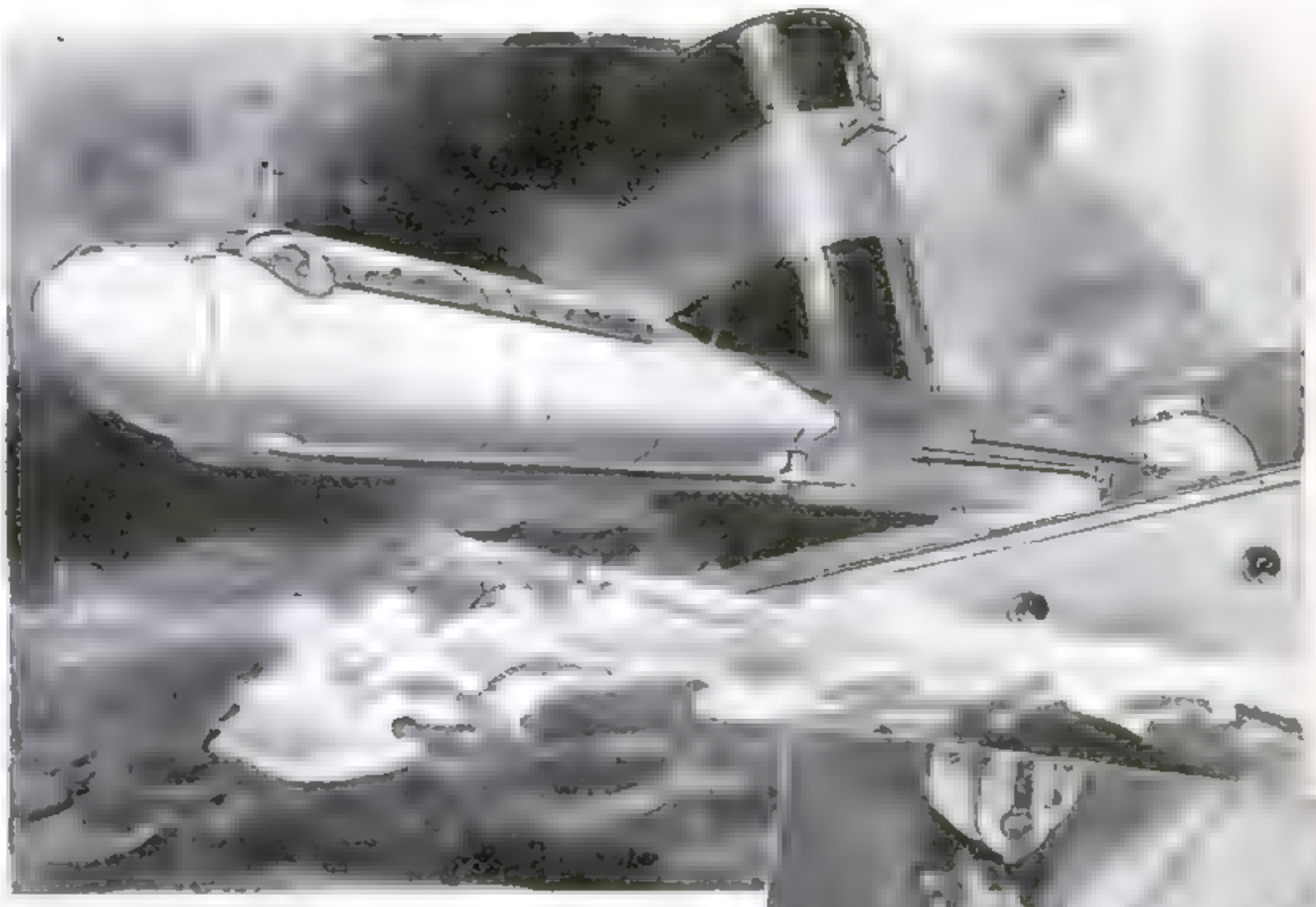


At right, a turntable and control panel for reproducing specially recorded music carried to subscribers by wires

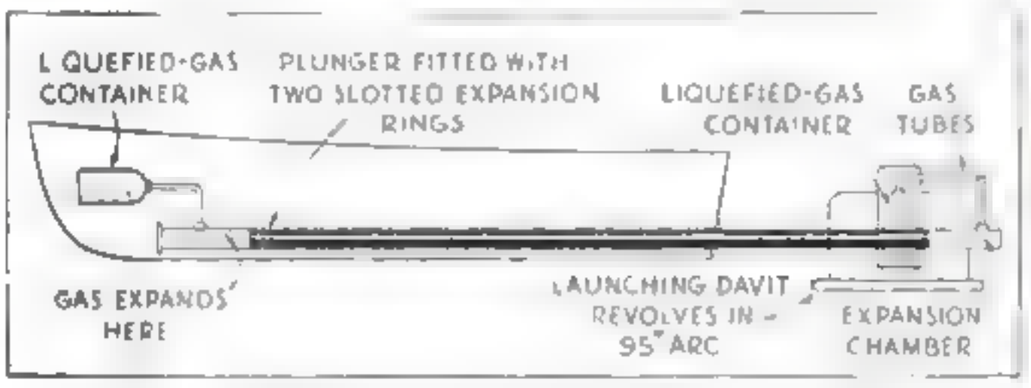
This screen-type receiver for hotel use conceals twin speakers, for both high and low frequencies

LIFEBOAT IS FIRED FROM SINKING SHIP LIKE A TORPEDO

SHAPED like a huge cigar, a new stainless-steel, torpedo-type lifeboat is designed to be shot through the air from a revolving launching davit fastened to the deck of a ship. The craft is so constructed that it will strike the water in a horizontal position, no matter at what angle or from what height it is launched, the inventor claims. Plungers attached to the launching davit fit snugly into elongated cylinders on the bottom of the lifeboat. When a control valve is opened, a special liquefied gas rushes from storage tanks in the lifeboat into air chambers at one end of the cylinders. Here the gas expands, exerts an enormous pressure against the stationary plungers, and catapults the boat into the sea. Similar storage tanks and expansion chambers at the davit ends of the plungers make it possible to launch the lifeboat from controls aboard the doomed vessel if necessary in an emergency. Lined with sponge rubber to cushion the launching and landing shocks, the lifeboat is equipped with radio, food and water supplies, distress rockets, and a powerful outboard motor. It is built with separate, air-tight compartments to prevent sinking if the outer hull is punctured at any one point. By sliding transparent panels over the cockpit, the craft can be completely sealed.



How torpedo lifeboat will shoot from launching davit into water. Right, storage tank for liquefied gas to give power

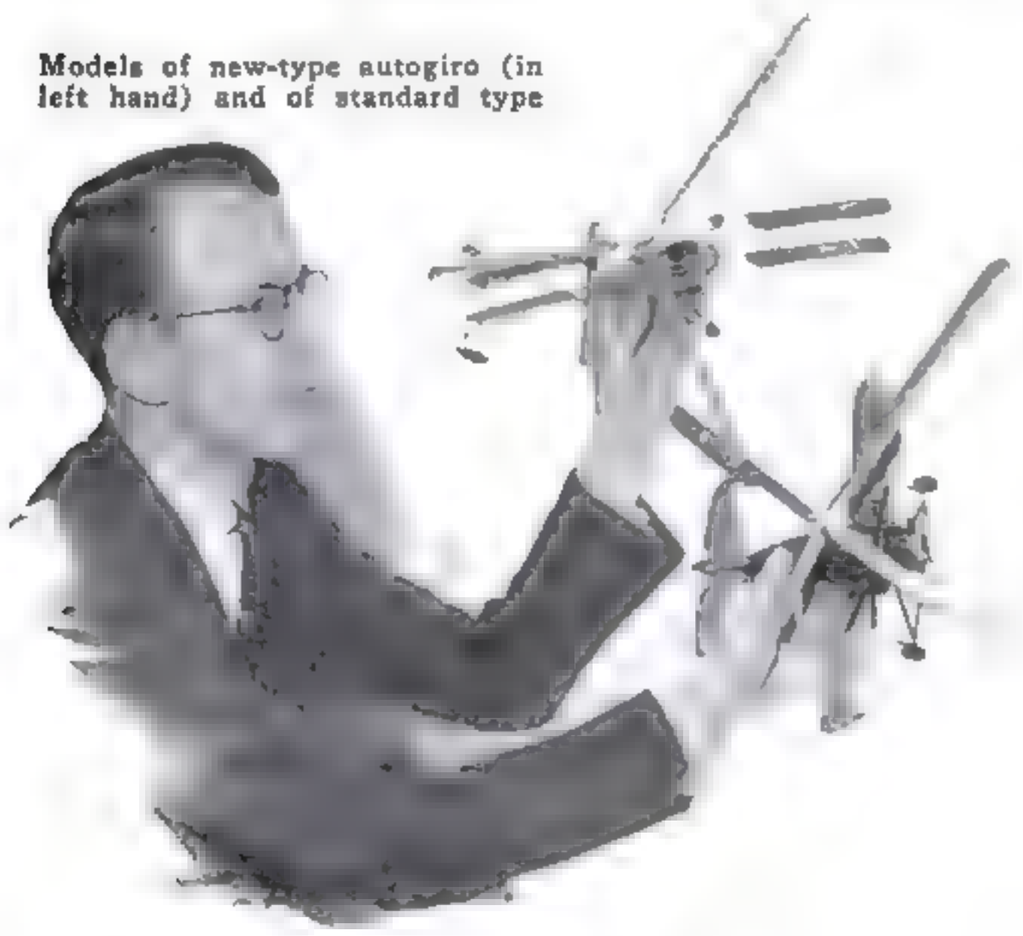


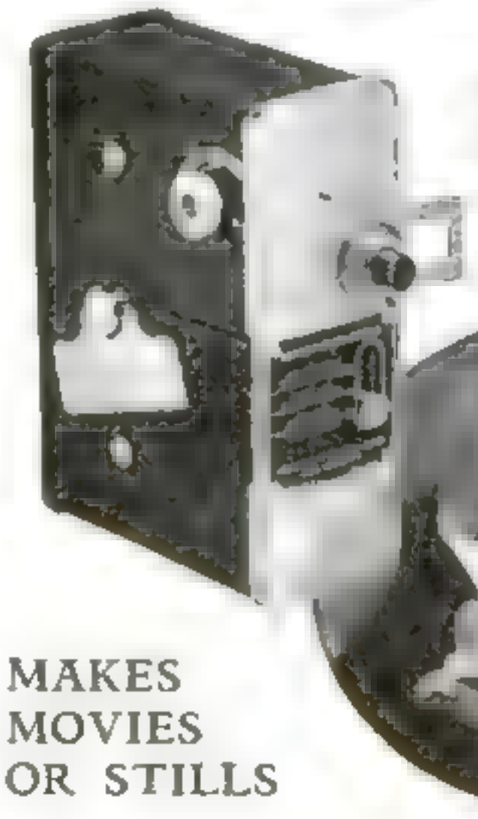
Details of launching mechanism. Gas admitted to cylinder from tank in boat or davit expands and catapults boat into the sea

AUTOGIRO HAS NO WINGS OR PROPELLER

WINGLESS and with no propeller, a test model of a new type of autogiro was recently exhibited by two Philadelphia, Pa., inventors. The odd plane will have a motor completely inclosed within the fuselage and geared to an adjustable, three-bladed rotor. Flattened out and whirling parallel to the ground, the rotor blades will lift the ship into the air, the inventors state. In flight the spinning blades, tipped at an angle by a cockpit control lever, will take the place of both wings and propeller in supporting the plane and driving it forward. Dual stablizing vanes, projecting fore and aft from the body of the ship, have been designed to counteract the tendency of the fuselage to spin in an opposite direction to the rotor. In case of engine trouble, the blades can be disengaged from the motor, and will spin freely to lower the plane to a slow, safe landing. Steering rudders are attached to the rear stabilizing vane. The radical departure from the conventional in the design of the plane will, it is believed after extensive wind-tunnel tests, permit abrupt take-offs, an extremely slow cruising speed, and safe landings within confined areas where only a limited runway is available.

Models of new-type autogiro (in left hand) and of standard type





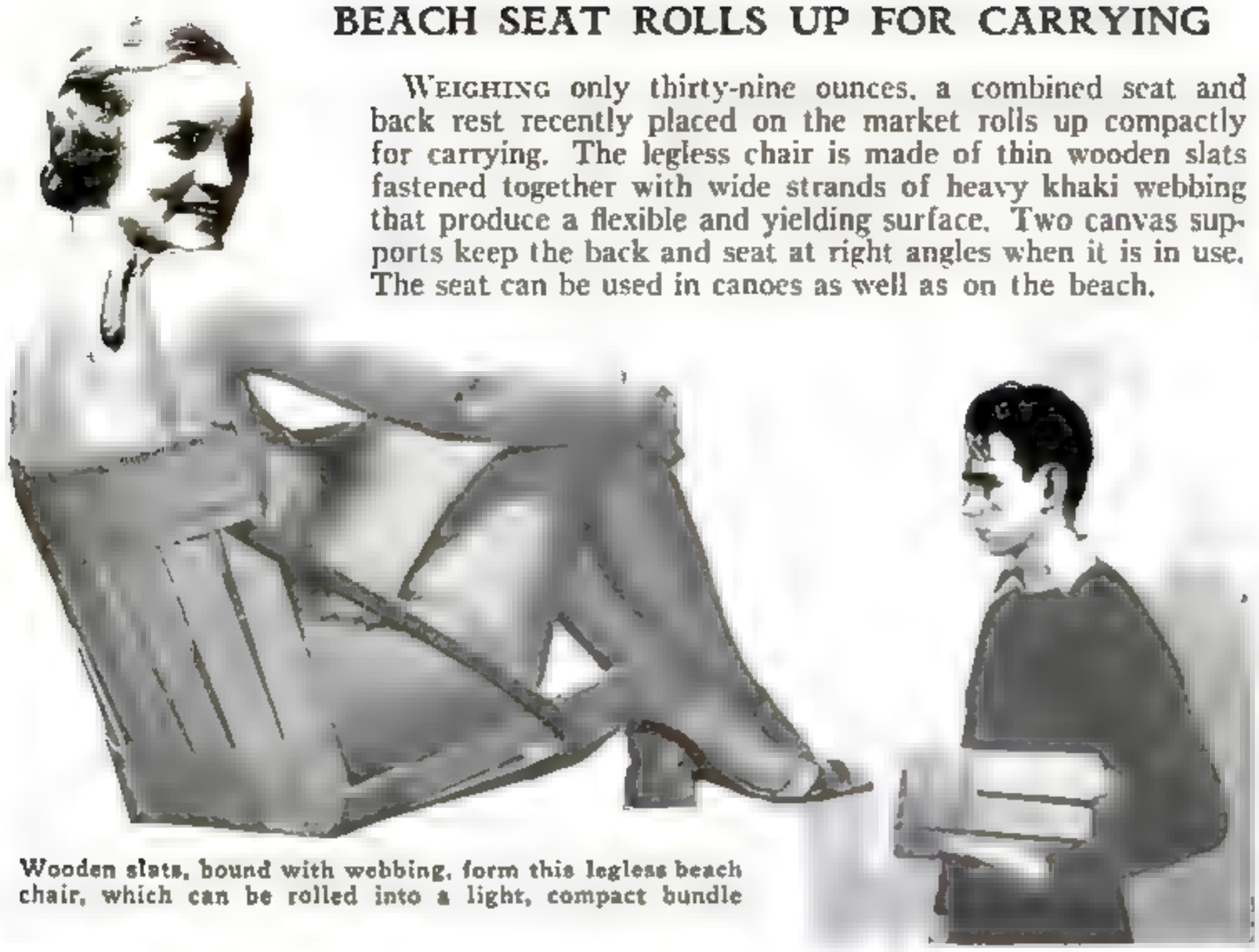
Inexpensive camera for movies or stills. Below, a "movie book" made by binding pictures together

MAKES MOVIES OR STILLS

BOTH snapshots and moving pictures can be taken with an inexpensive camera just marketed. It will take forty separate photos of vest-pocket size, or make a regulation sixteen-millimeter movie film for projection. As an added feature, the movie film can be printed and bound in a "movie book," to be flipped through with the thumb, giving an animated picture.

BEACH SEAT ROLLS UP FOR CARRYING

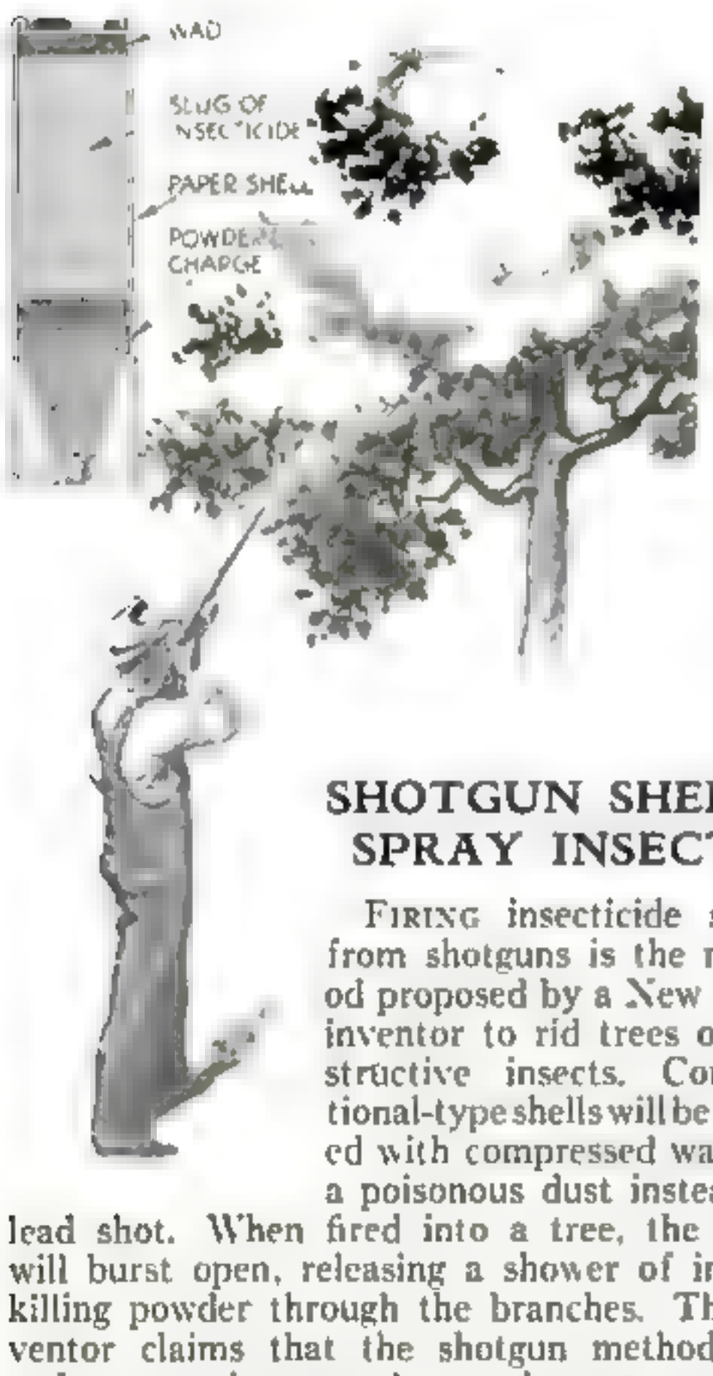
WEIGHING only thirty-nine ounces, a combined seat and back rest recently placed on the market rolls up compactly for carrying. The legless chair is made of thin wooden slats fastened together with wide strands of heavy khaki webbing that produce a flexible and yielding surface. Two canvas supports keep the back and seat at right angles when it is in use. The seat can be used in canoes as well as on the beach.



Wooden slats, bound with webbing, form this legless beach chair, which can be rolled into a light, compact bundle

WINDOW IN LIVE RAT SHOWS VITAL PROCESSES

INSERTED into the side of a live rat, a transparent celluloid window enables students in an Iowa college to study the muscular movements and blood flow of the animal's intestines. Since the internal organs of a rat are physiologically similar to those of man, the rodent unwittingly serves as a living textbook.



SHOTGUN SHELLS SPRAY INSECTS

FIRING insecticide shells from shotguns is the method proposed by a New York inventor to rid trees of destructive insects. Conventional-type shells will be loaded with compressed wads of a poisonous dust instead of lead shot. When fired into a tree, the slugs will burst open, releasing a shower of insect-killing powder through the branches. The inventor claims that the shotgun method will make expensive spraying equipment unnecessary and, in addition, will afford adequate protection to workmen from the poisonous powder.

SEA YIELDS MAGNESIUM

SALTS extracted from sea water are now yielding the lightweight metal magnesium in large-scale quantities, for uses that range from the manufacture of flash-light powder to the building of gondolas for stratosphere balloons. Compounds of magnesium are also obtained for use in tooth powders and pastes, antacid powders and tablets, ointments, and face powders, as well as for the preparation of milk of magnesia, of which the United States consumes 15,000 gallons a day.

GEOLOGY STUDENT FINDS RARE FOSSIL

ONE of the rarest fossils known to man was recently discovered in a stone quarry by a geology student at Colgate University, Hamilton, N. Y. Believed to be 275,000,000 years old, the fossil was identified as a brittle star, a marine animal closely resembling the common starfish.

Whitney Jaeger displaying the rare fossil he discovered. At left, brittle star in close-up, and its outline in rock

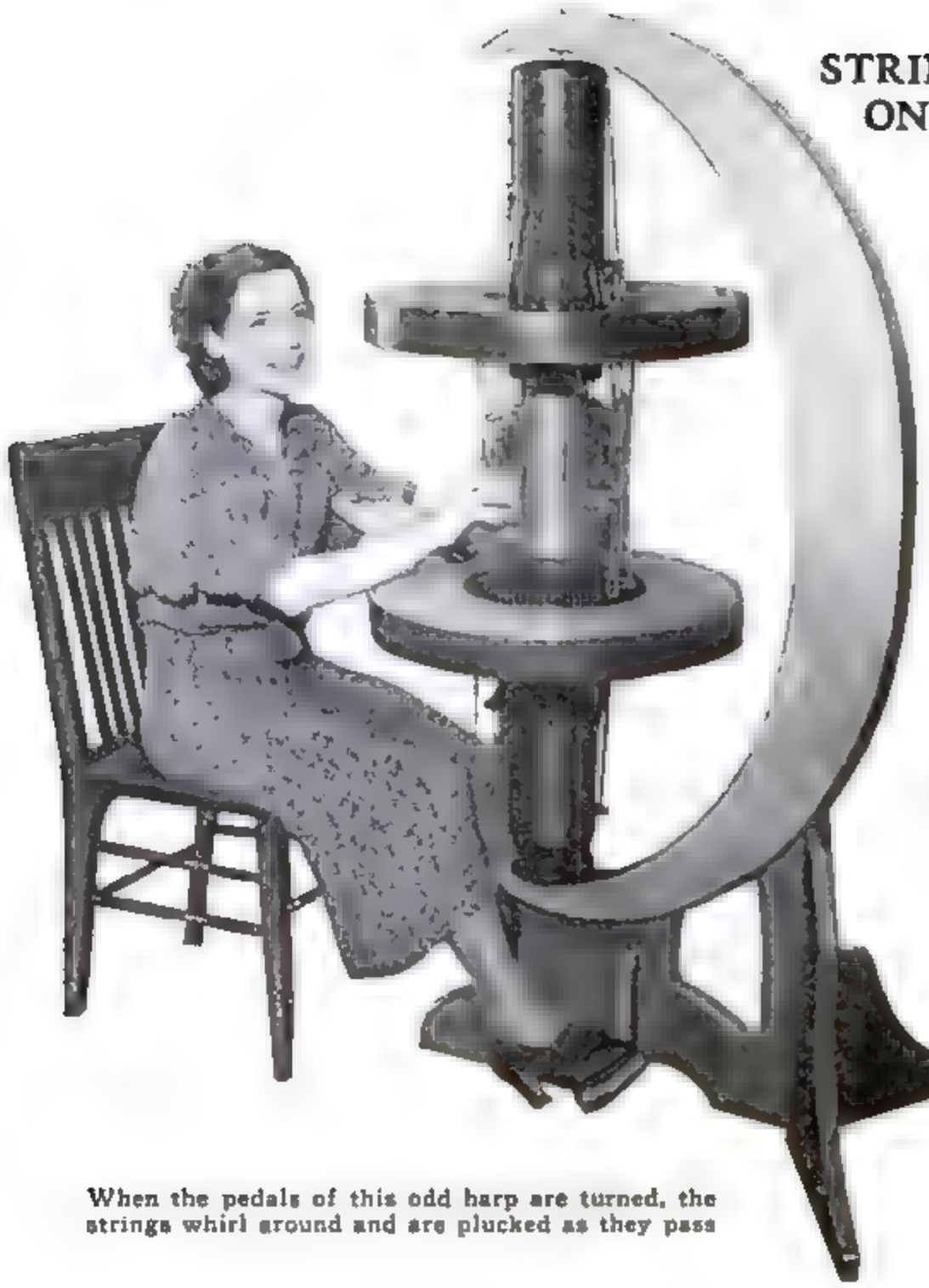
"PIPE LINE" CARRIES RADIO WAVES

HIGH-FREQUENCY radio waves are "piped" through long rods of insulating material instead of wires in a new transmission system recently developed by Dr. G. C. Southworth of the Bell Telephone Laboratories. Only six inches long, the waves travel along the rod in much the same manner that the human voice follows a speaking tube. Because of the simplicity of the receiving circuit required, the new system may prove valuable in the intercity transmission of television broadcasts.

Experimental "pipe line" for transmitting radio waves without interference. Dr. G. C. Southworth is holding a receiving unit

STRINGS GO 'ROUND ON NOVEL HARP

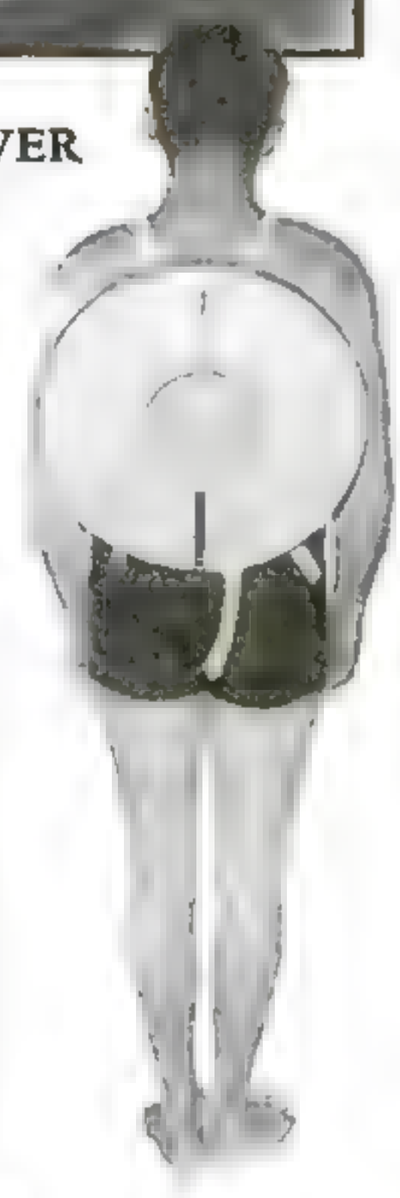
UNUSUAL musical effects may be evoked from a "merry-go-round" harp created by three Seattle, Wash., musicians. By operating foot pedals like those of a bicycle, the performer rotates a five-foot vertical spindle carrying the strings, and plucks them as they go past. The odd mechanism provides enough strings to play four chromatic octaves on a portable instrument, and brings them all within easy reach of the player. A pair of disk-shaped sounding boxes, attached to the spindle, enhance the tones produced. The inventors, who have named the instrument "rondolin," expect their unusual harp to find a place in concert as well as dance orchestras.



When the pedals of this odd harp are turned, the strings whirl around and are plucked as they pass

LIFE PRESERVER FITS NECK

A LIFE PRESERVER of new design, carried on the back of a life guard, aids in rough-water rescues. When tied around the neck of a swimmer in distress, it buoys him up while being towed, or keeps him afloat until additional aid arrives. The device is effective in saving a bather who handicaps his rescuer by struggling. The illustrations show the preserver in use, and the manner in which it is conveniently worn by a beach guard while on duty.



COMBINES CHECKERS, CARDS, AND CHESS

FEATURES of chess, checkers, and cards are combined in a novel game just introduced for two or four players. A modified checkerboard serves as the playing field, while the pieces are oblong blocks marked with the familiar playing-card designs in miniature. Each player starts with thirteen pieces of one suit, and his object is to move as many of his high cards as possible into the back or "scoring" rows of his opponents. Moves and jumps are similar to those in checkers. When four are playing, each player must guard against the moves of three adversaries, and the game takes on many of the multiple hazards and complexities of chess which have made that game popular for generations.

Cardlike pieces used in a new game played on a modified checkerboard. Above, a group at play

RAPID-FIRE GUN SHOOTS TEAR-GAS PROJECTILES

A TEAR-GAS "machine gun," recently demonstrated before Detroit, Mich., police officials as a means of dispersing rioting mobs, shoots a rapid-fire stream of self-exploding projectiles that scatter the blinding vapor they contain in all directions. A rotating magazine, which carries the shells, can quickly be reloaded when the supply is used up. The gun has a range of several hundred feet, and its makers claim it outranks any single-shot weapon of this type in mob-dispersing effectiveness.

When Machines "Get Rhythm"

To determine the effect of excessive vibration on the various parts of an automobile, a manufacturer uses the "Belgian roll," a device that literally pounds a car to pieces by exaggerating the stresses of ordinary driving. In the photograph above, a 1936 model is being put through this rigorous third degree

By JESSE F. GELDERS

AN AIRPLANE crashed in a Texas cotton field, killing its pilot. Investigators, seeking the cause of the tragedy, discovered the engine missing from the plane. They found it in another field, hundreds of yards away. It had fallen out in midair.

A motorist, driving through a rainstorm, switched on his electric windshield wiper. It worked well, but it filled the closed car with a hum so annoying that the driver shut it off at the first opportunity. Back in the factory where the wiper was made, experts were trying to find an economical way to get rid of this hum. They failed, and in a few months that type of wiper practically disappeared from the market.

The crash of the airplane and the whine of the windshield wiper may not seem to have been related in any way. But they were. Both were caused by the same trouble—vibration.

It hadn't been considered serious in either case. The plane motor had apparently been running smoothly enough. But insignificant tremors weakened its moorings until they let go in sheer fatigue. The little rotor driving the windshield wiper had a quiver of only about one ten-thousandth of an inch—a twentieth of the thickness of a human hair. But the windshield made a sounding board that filled the whole car with its hum.

The same principle, in some form or other, causes troubles ranging all the way from the shimmying of auto wheels to the violent throbbing of huge ocean liners, baffling engineers who thought they had produced vibrationless ships. It is this force that snaps the propellers of airplanes in midair, or tears off their wings; it wrecks giant turbines, and sets up mysterious noises in buildings hundreds of feet away from any machinery.

Newly recognized dangers of vibration are a major problem today in scores of industries. Great sums are spent to eliminate it. Specialists are busy discovering and correcting it whenever it occurs. They hunt it and analyze it with an array of instruments including metal reeds that look like musical tuning forks, stethoscopes such as doctors use to listen to the human heart and lungs, and tiny seismographs similar to the larger ones that record earthquakes.

Although vibration occurs in many forms, it is being recognized as a single and special problem, running through the various fields of engineering and physics. Within the last few years, a whole new science has been built around it. Universities teach the subject as an important unit in their engineering courses.

To get the real story of the destructiveness of vibration and of its astonishing pranks, I talked with Professor G. B. Karelitz, of Columbia University, and with service experts of the Westinghouse and General Electric companies. Much of the scientific study of the subject was pioneered in these two companies' laboratories. Professor Karelitz himself was formerly a member of the Westinghouse research staff.

Aircraft manufacturers, he told me, probably are the worst sufferers from vibration. No one knows how many of the unexplained flying tragedies it has caused, but enough pilots have landed safely after mishaps, and enough investigations have been made, to disclose the hazards.

When a test pilot takes a new plane 15,000 or 20,000 feet aloft for its tryout, one of his chief concerns is "wing flutter," caused by vibration in the wind. Frequently, the flutter has become so violent that the wings were ripped off.

The terrific strain which wind vibration can cause may be understood through comparison with a curious accident which has be-

Even radio actors must combat vibration. This artist is singing inside a transparent bell to shield the microphone from unwanted quivers caused by high notes

CURIOUS PRANKS OF VIBRATION CREATE NEW ENGINEERING PROBLEMS

Control surfaces of an airplane being tested by an ingenious machine to determine whether they vibrate at the same rate as the supporting structure. If they do, dangerous flutter may result

Below, an electromagnetic instrument that measures the velocity of vibration in the noise-producing frequency range. With the contact rod against the vibrating object, the dial records speed of vibration

fallen several large steam turbines. The steel blades of the turbine fluttered in the path of the steam, trembling only about a hundred-thousandth to a ten-thousandth of an inch, but fatigue made them snap in two.

Aircraft builders in recent years have become aware of a still more astonishing hazard. Each time a propeller blade passes in front of a wing, the air resistance stiffens. The piled-up wind force gives a jolt to both the wing and the blade. Coming at swift, steady intervals, those jolts cause vibration.

Before designers learned to avoid this danger, many an apparently sound propeller broke mysteriously, flinging its blades into the air and leaving the pilot to glide to a dangerous landing, or take to his parachute.

The uncanny violence of those vibrations was the result of a simple principle. With only your breath you can move a comparatively heavy pendulum, or a weight hung by a string. If you blow each time the weight is moving away from you, or each second time, you can soon have it swinging wide. As long as your breath is in harmony, or resonance, with the vibration, the pendulum will add up the forces of all your little puffs, and pack them into its momentum.

Like a pendulum, any vibrating object tends to make a complete swing, back and forth, in exactly the same length of time, regardless of how slightly or how hard it is vibrating. The broken airplane-propeller blades at first had trembled only mildly from their impacts with the piled-up wind in front of the wings. But when the motor whirled them faster and they reached a certain speed, those impacts fell in resonance with the blades' vibration. The vibration was increased, in the same way that the pendulum gained momentum. The rapid, fierce bending back and forth caused the metal fatigue which finally made the blades snap off.

Resonance has been to blame also for the falling out of many airplane engines. The ordinary firing of the cylinders, or a lack of perfect balance in the rotating parts, causes a motor to shiver a little on its foundation. But at its so-called "critical" speed, the shocks suddenly come in harmony with the shiver. They build up a terrific force which weakens the fastenings and finally tears the motor loose.

While gathering information about such grim results of vibration, I learned with amazement that this phenomenon was responsible for a strange, almost comical, personal experience which several times puzzled me when driving an automobile.

Going about thirty-five miles an hour on a concrete highway near Oklahoma City, the car began to rise and fall on its springs, as if it were passing over long, low waves. Although the road appeared perfectly level, the car was soon pitching so violently I had to slow almost to a stop.

I talked with other drivers who had the same puzzling experience on that one particular stretch of road, and we concluded it must be caused by waves in the pavement that we could not see.

I have just discovered that we were wrong. The real cause was the innocent-looking, tar-filled expansion joints, spaced at regular intervals along the highway. When a car passed over one, the springs would take the jolt, after which the body would rise and fall almost imperceptibly. But at about thirty-five miles an hour, each time the body was coming down, the wheels would hit another joint. It was just as if some one were jumping up and down on the bumper in time with the vibration of the springs. Only, instead of jolting the body downward, the pavement joints were jolting the wheels upward.

Cars with soft *(Continued on page 116)*

This Diesel train runs on pneumatic tires and also has a rubber-cushioned coupling to minimize vibration

At the right is an aquarium rigged up to test the sense of hearing of fish. A submerged telephone receiver emits a sound, and at the same time the fish receives a gentle electric shock through a wire leash. After a few experiences, the fish learns to jump at the sound, without a shock

Can Fish Hear?

"DUMB" animals are learning to talk. Not by word of mouth, but in roundabout ways they are telling scientists how they feel, what they see and hear, and even what they think about. Age-old mysteries—always the source of controversy—are evaporating as research workers peer into the minds of inarticulate creatures.

Only recently have experimenters succeeded in hurdling what has long been an insurmountable obstacle—the fact that animals, unlike human laboratory subjects, cannot give verbal reports of their experiences and emotions. Through ingenious artifices that establish, in effect, a common language between the animals and their investigators, their innermost sensations are now being revealed

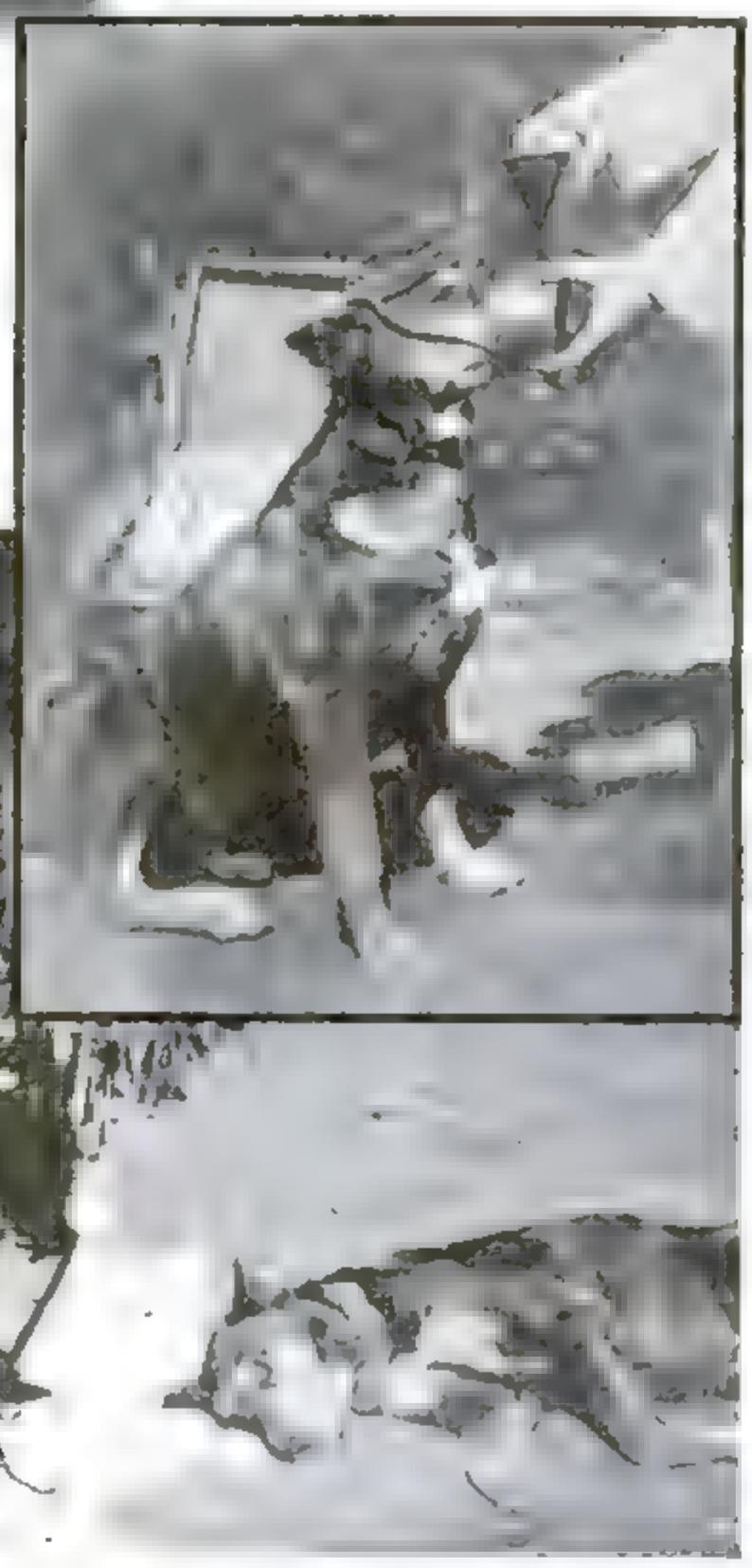
To test the acuteness of an animal's senses, such as smelling and hearing, P. Hachet-Souplet, director of the Zoölogical Institute at Paris, France, employs highly intelligent dogs that have been trained to stand up, seat themselves, or lie down at a command.

Through a funnel, he saturates a sponge strapped over the nose of one of these subjects with a strong-smelling liquid, like formic acid or lactic acid. Promptly the dog is instructed to lie down. Again and again the procedure is repeated, until the dog reclines of its own accord at the first whiff. Now the investigator gradually diminishes the dose of odorous fluid with each test. Presently the dog fails to respond. By this signal, the experimenter knows that the odor is too faint to recognize. He has reached the limit, or "threshold," of the dog's ability to detect the smell, and the quantity of pungent fluid employed in the final trial is a true measure of the dog's keenness of scent. The tests not only confirm the belief that a dog can perceive far fainter odors than a human being can, but also show exactly how much superior its ability is.

For a test of hearing, the investigator uses the sound of water dripping upon a metal disk. In this case, the dog is taught to rise from a lying position when it hears the sound. By using disks of different tonal qualities, it is possible to determine how the dog's acuteness of hearing varies with the musical pitch of the sound, as well as with its loudness

More generally in vogue among experimenters is the scheme of training an animal to give responses, or "conditioning" it, by the use of mild electric shocks.

A dog demonstrating that he can recognize colors. Holes in a revolving disk are bordered with different colors, and morsels of food are put behind the disk only when a given color appears at the bottom. The canine learns to pounce only at that color



MEASURING A DOG'S KEENNESS OF HEARING AND SMELL

This animal has been trained to get up when he hears a drop of water strike the metal disk attached to the stand. The test proves that he can hear sounds imperceptible to man. The inset shows an experimenter saturating a muzzle sponge with odorous liquid to gauge the sense of smell

Fish in the tank at the left have learned to expect food when the disk rotates to produce a gray color. They make no effort to eat when the disk is stationary, proving that they can distinguish between different hues

Even the anteater has been enlisted as a laboratory assistant. This one is sticking its long tongue into a red-painted container which, experience has taught him, contains food he likes

..STRANGE TESTS GAUGE SENSES OF DUMB CREATURES

This method has the outstanding advantage of being applicable to virtually all kinds of animals. A Russian experimenter, Prof. J. P. Frolov, recently used it to study the hearing of fish!

No organ of hearing has ever been discovered in a fish, he points out, yet a wily fisherman never talks while he is fishing. Can a fish really hear?

To find out, he tethered a fish in a small aquarium upon a light, flexible electric wire, with plenty of slack for his subject to swim freely. At the touch of a key, a telephone receiver submerged in the water emitted an audible sound, while the fish simultaneously received a gentle electric shock through its wire leash. It responded with agitated movement. After repeated trials, Prof. Frolov omitted the shock and sounded the telephone signal alone. To his delight, the fish leaped into action as before! Evidently the fish could hear the sound, had learned to associate it with receiving an electric shock, and jumped even when no shock was forthcoming. Even the ringing of a bell suspended above the water proved audible to a fish in further tests.

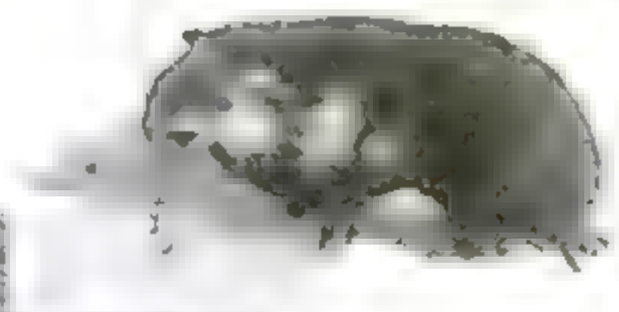
As universal as dislike of an electric shock, in the animal kingdom, is the desire for food, and this affords still another way of plumbing the minds of animals.

That apes rival human beings in ability to distinguish colors was demonstrated by the late dean of Russian psychologists, Prof. Ivan P. Pavlov, who trained a monkey to climb down from its perch for food when he displayed a red disk as a signal. Raising a blue disk brought no response, for the monkey had learned that no food would be forthcoming. Similar tests show that dogs, cats, fish, and guinea pigs can tell the difference between different hues. The director of the Paris zoo found it possible to train a dog to seize a morsel of food, placed behind a slowly revolving disk with four holes rimmed in different colors, only when an aperture of a certain color came into position.

Can animals reason, as human beings do? Again, their ingenuity in seeking food supplies the test. The French experimenter demonstrates the intelligence of a beaver by hanging a can of grain above its reach, with a cord anchored at the floor. Soon the beaver learned to gnaw through the cord so that the can would fall and spill, providing a feast.

It is methods such as these that permit animals to serve as subjects for practical medical research.

A water rat, blindfolded, finds its way to marshy soil with only its sense of smell to guide it. It can determine the direction by greater humidity of the air



This beaver showed a remarkable ability to think things through. To get at food suspended in a pail overhead, he gnawed through a cord supporting it and then enjoyed a feast

That moles have an ear for music was proved with the odd apparatus at the left. Placed in a tank in such a way that his motions were visible, he was seen to react in different ways to various musical sounds produced on a phonograph. The tests were performed at the University of Hamburg, Germany

EYE TEST SHOWS UP TIPSY DRIVERS

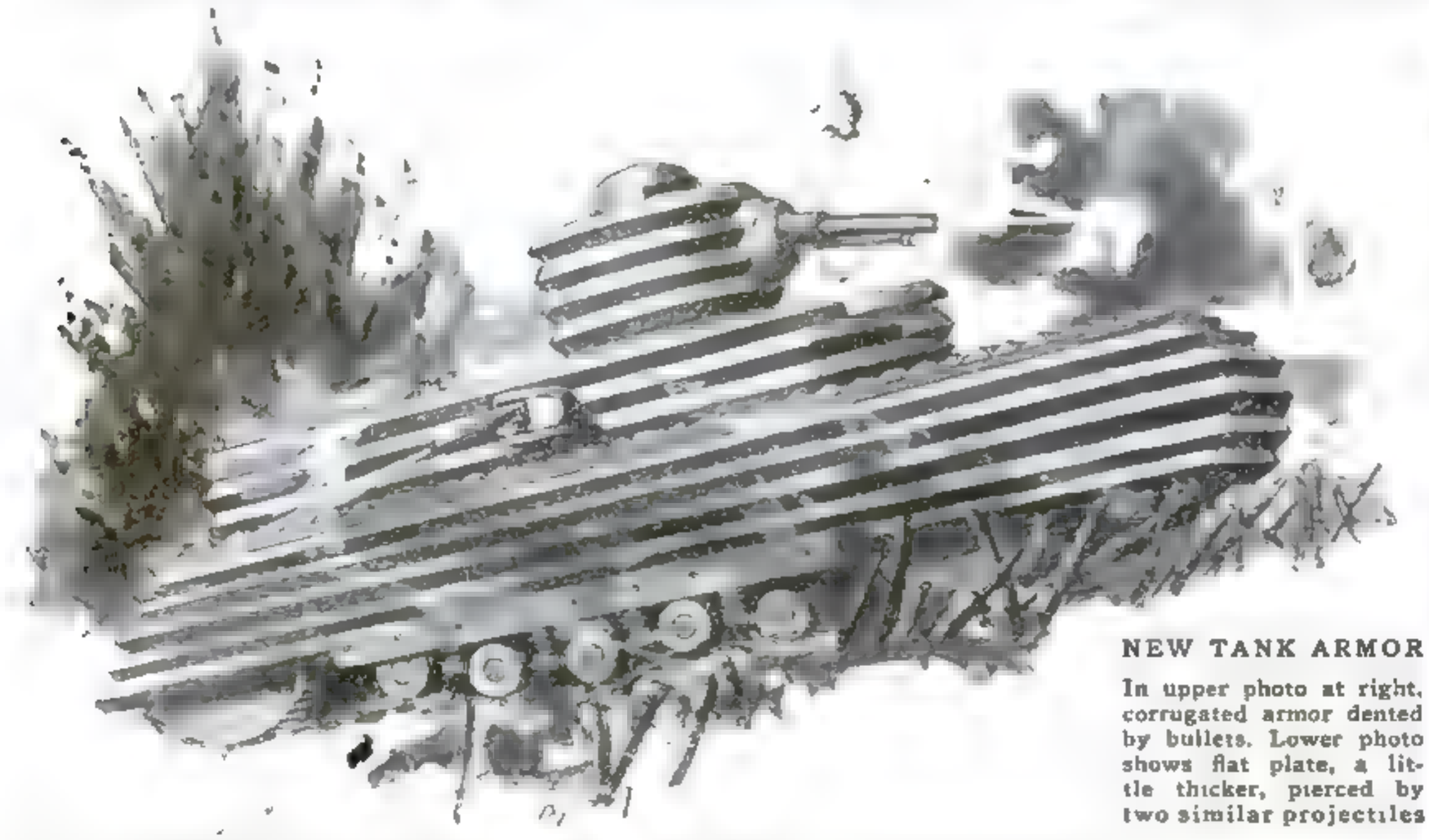
MOTORISTS suspected of driving while under the influence of liquor are subjected to a novel "alchohol test" devised by a Cleveland, Ohio, police sergeant. Based on the fact that alchohol affects man's ability to focus his eyes on a single object, the test utilizes a stereoscope and a set of specially prepared pictures. A sober person, looking through the two lenses, sees one image and can describe it correctly. However, a subject even slightly intoxicated is unable to focus his eyes properly; he sees a dual or blurred image, and cannot describe the object pictured. The drinking of three ounces of whiskey was detected in test subjects. In cases of alleged drunken driving, Cleveland traffic-court judges are accepting the evidence of the "alcohol detector" as proof of intoxication.

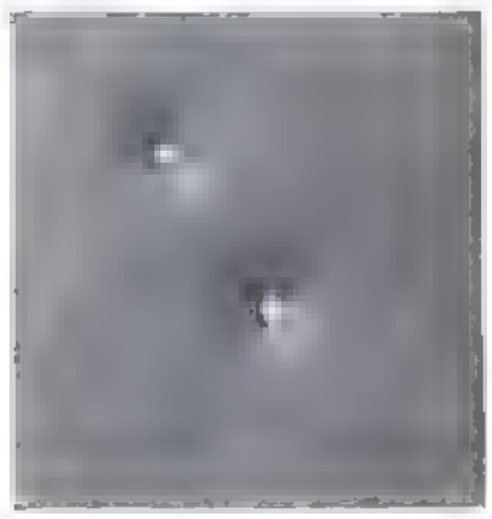
Cleveland, Ohio, police chief inspecting Sergeant Arthur Roth's device for detecting tipsy drivers. Viewed by a sober person, images in inset would merge

COATS COAT COAT STORE AS NOVEL SALES SCHEME

OVERSTOCKED with a large supply of men's spring and winter coats, a clothier in Copenhagen, Denmark, adopted a unique sales scheme. He erected a scaffolding around his store building and completely covered it from roof to sidewalk with more than a thousand overcoats. The novel display attracted prospective customers in such droves that police were summoned. Although the police ordered the proprietor to remove the display, he succeeded in selling all the overcoats.

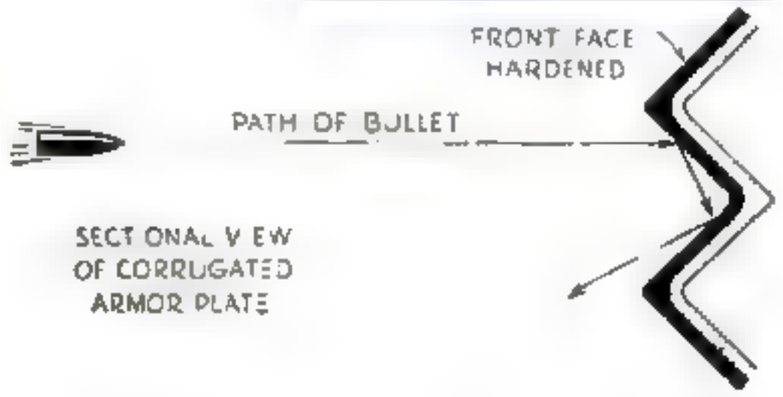
CORRUGATED PLATING DEFLECTS ARMOR-PIERCING BULLETS





NEW TANK ARMOR

In upper photo at right, corrugated armor dented by bullets. Lower photo shows flat plate, a little thicker, pierced by two similar projectiles



BY FURROWING the surface of metal plate with angular ridges, a Philadelphia inventor has materially increased the strength of armor designed for use on tanks, warships, and aircraft. In recent ballistic experiments conducted before ordnance experts, high-powered bullets fired from a distance of fifty yards pierced a test section of flat armor plate one half inch thick. When a slightly thinner section of corrugated armor was used, however, bullets fired from the same distance failed to penetrate its surface, but ricocheted off the sides. Armor penetration depends on a bullet's angle of impact. Corrugated armor plate, the inventor explains, presents a surface inclined at an angle of forty-five degrees; bullets strike it a glancing rather than a direct blow.

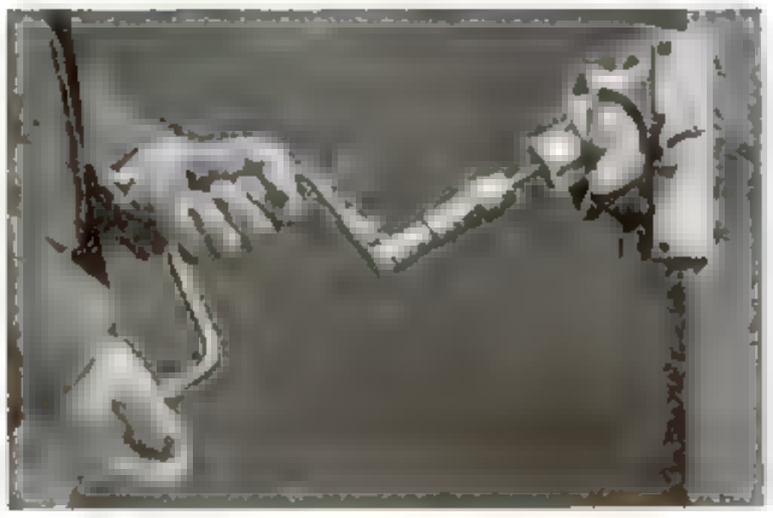
BIKE FOLDS AND BOAT COLLAPSES IN AMPHIBIAN OUTFIT

AN UNSINKABLE one-man canoe, built by a French inventor for use on outings, splits into three sections and can be compactly stacked on a small trailer attached to a collapsible bicycle. For use in the water, the three sections of the boat can be quickly assembled, and inflated rubber tubes prevent sinking if the craft capsizes. The small-wheeled bicycle, devised by the same inventor, is so constructed that it folds in half and can be stowed away with the trailer aboard the boat. The two inventions thus combine to make an amphibian outfit so that the tourist or camper is equipped for traveling both afloat and on shore.

Collapsible canoeknocked down and packed on a bicycle trailer

In inset, the canoe is in use and the bicycle gets the ride

DRILL GUIDE HOLDS BIT AT ANY ANGLE

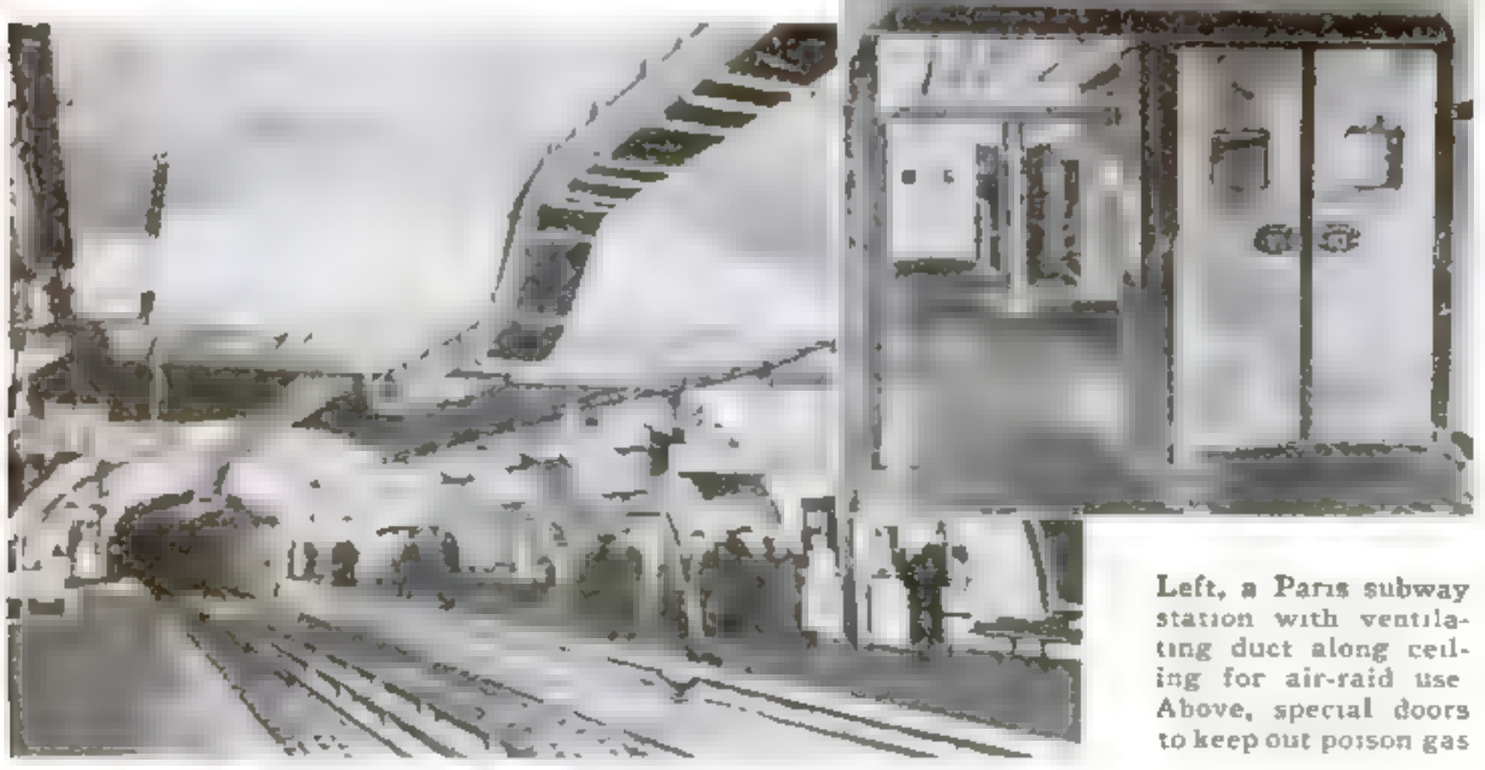


Drill guide clamped to material to hold auger bit

BORING holes at any desired angle with an auger bit or drill is made easy by an adjustable drill guide recently invented. Equipped with a built-in protractor for gauging angles, the device can be clamped to either wood or metal, set at a given angle, and locked in position with two set screws. When a bit is inserted in the guide, it is held securely by a metal collar and directed accurately into the material being drilled. The device will accommodate various sizes of drills, ranging in diameter up to one inch.

SUBWAY FITTED AS AIR-RAID SHELTER

CAVERNS, abandoned quarries, and other excavations which honeycomb the foundations of Paris, France, have been suggested as civilian shelters from war-time air raids. Steps have already been taken by the government to adapt existing subway stations for emergency shelters. One of these has been equipped to accommodate 8,000 persons. Far enough below the surface to withstand the shock of direct hits from bombs, the station has special gasproof doors and is fitted with an elaborate system of fans, filters, air ducts, and other ventilating equipment.



Left, a Paris subway station with ventilating duct along ceiling for air-raid use Above, special doors to keep out poison gas

TINY RADIO IN BALLOON SENDS WEATHER REPORTS

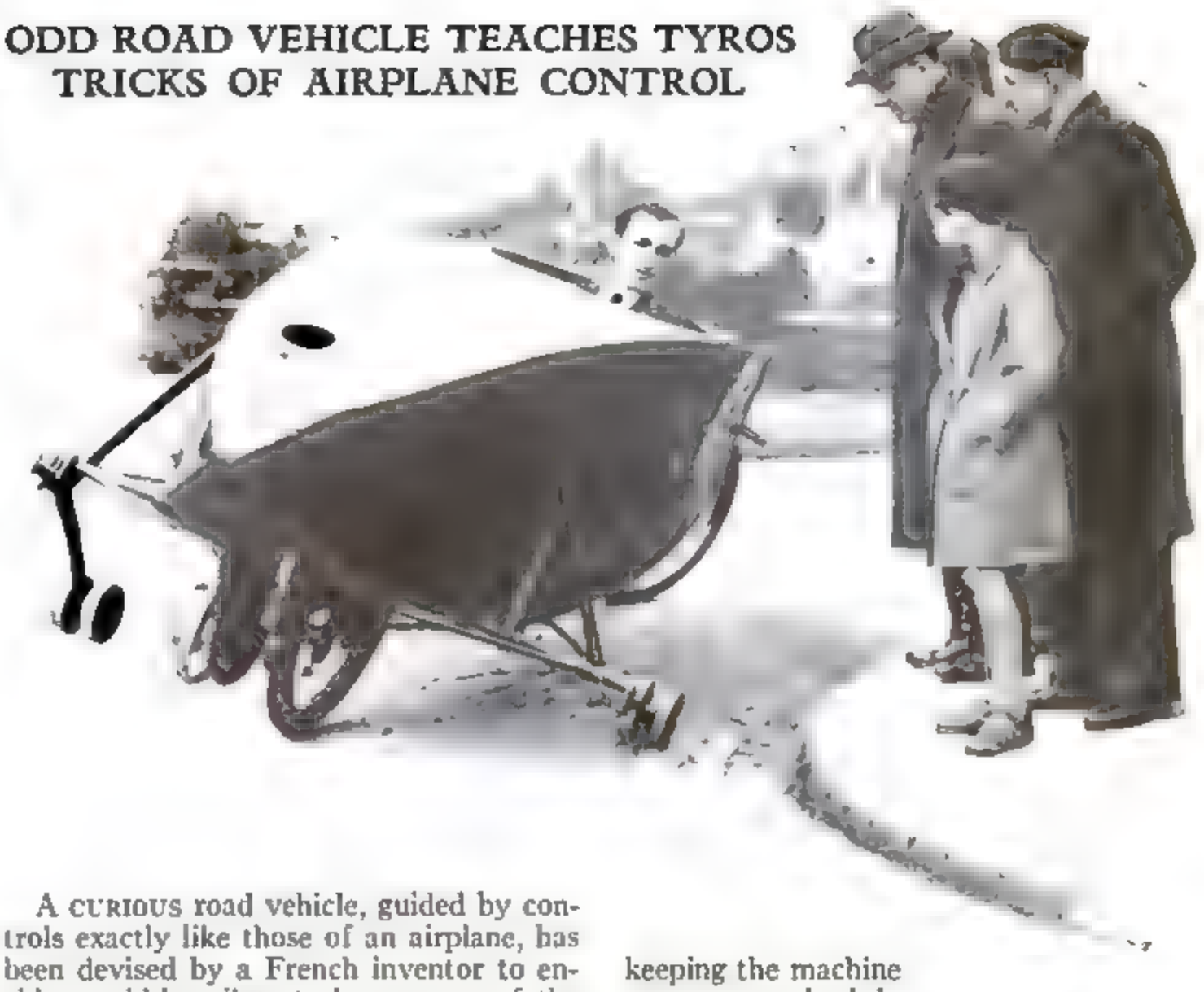
WEIGHING only one pound, a tiny radio device constructed by a U. S. Army officer is designed to record and broadcast weather data from the stratosphere. The apparatus, called a radiometeorograph, combines weather-recording instruments with a diminutive radio transmitter. Sent aloft in a small balloon capable of reaching an altitude of 90,000 feet, the device automatically flashes code signals revealing temperature, humidity, and atmospheric pressure for use by meteorologists in forecasting weather conditions. It is expected that the apparatus will supplant the airplane weather-recording flights now made daily at twenty-two air fields in the United States. In the photograph above, the inventor, Capt. O. C. Mair, U.S.A., is shown with the radiometeorograph at the California Institute of Technology, where he conducted his experiments.

Jets of compressed air are blown down over face as screen

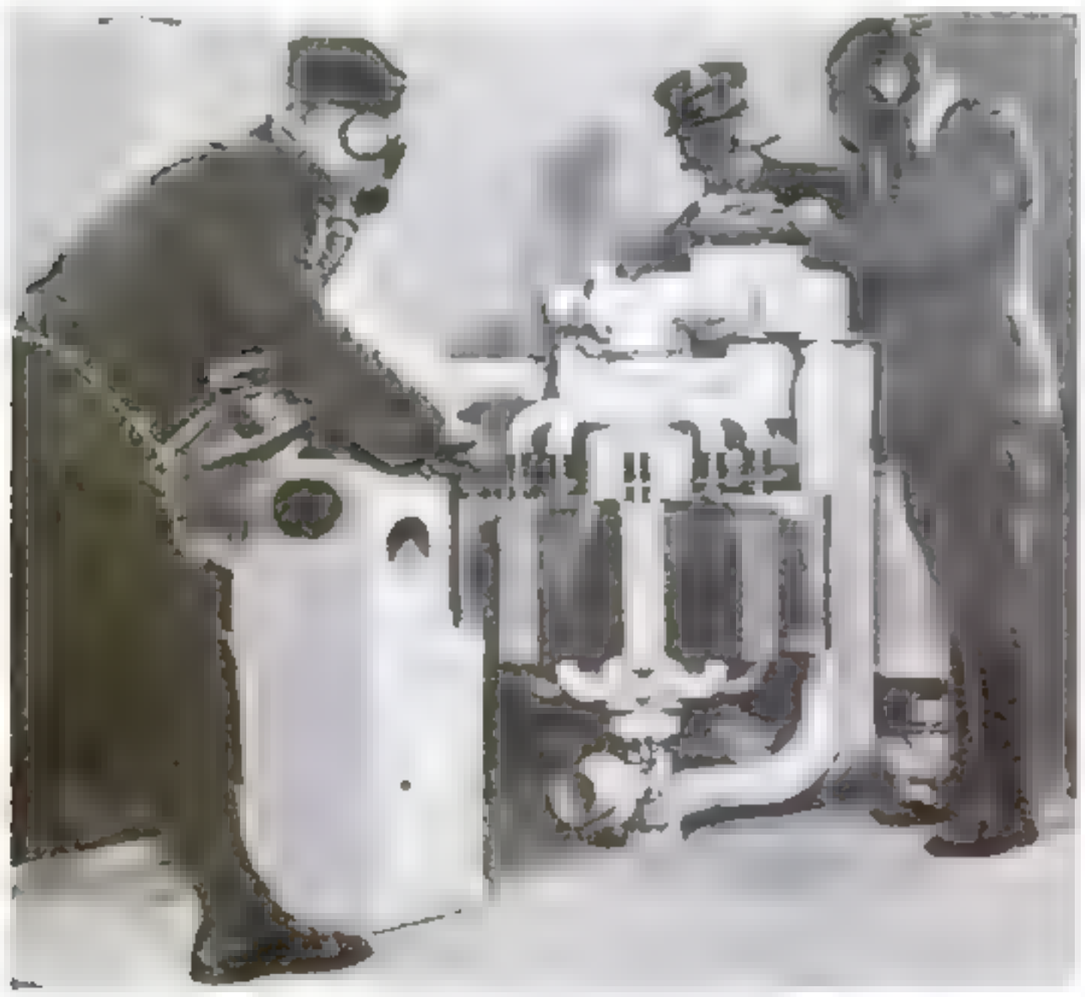
AIR SCREEN FORMS MASK TO GUARD AGAINST DUST

PROTECTION from gas fumes, smoke, paint spray, and flying dust particles is provided by a new type of face mask recently patented. A hollow-rubber visor, strapped to the forehead, has a row of pin-point holes along its bottom edge. Compressed air, pumped into the visor through a connecting tube, streams out of the tiny perforations and downward over the wearer's face as a transparent protective curtain or air screen. The air mask offers no discomfort to the wearer.

ODD ROAD VEHICLE TEACHES TYROS TRICKS OF AIRPLANE CONTROL



A CURIOUS road vehicle, guided by controls exactly like those of an airplane, has been devised by a French inventor to enable would-be pilots to learn some of the maneuvers of flight without leaving the ground. Wheels on outriggers simulate the action of ailerons on a plane's wings, keeping the machine on an even keel in straightaway travel and controlling its tilt in rounding a turn, as demonstrated by the inventor in the illustration above.



Resembling a vacuum cleaner, this machine rids air of poison gas

AIR PURIFIER DISSOLVES POISON GAS

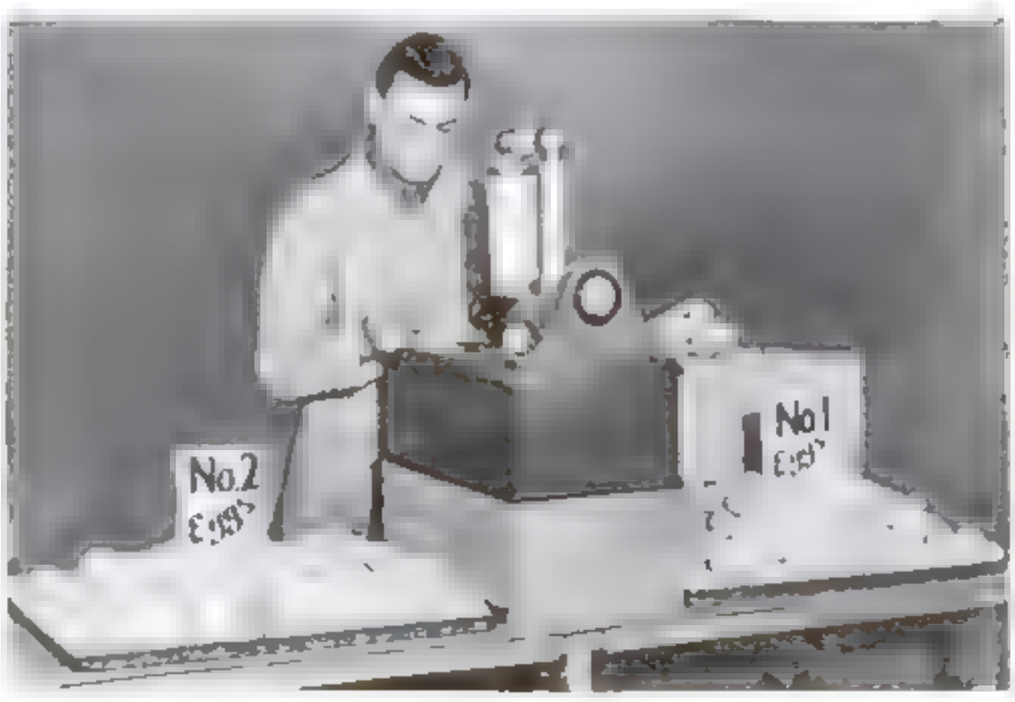
WILL poison-gas attacks be robbed of their terrors by new machines that suck up and destroy the toxic vapors? Built like a vacuum cleaner, a device demonstrated recently at Milan, Italy, draws the surrounding air through chemical tanks where any poisons it may contain are neutralized. Small machines of this type, according to the inventor, may be used to maintain a supply of purified air for refugees in gasproof shelters, while larger models may be employed to destroy poison gas in the open air.

SEWING MACHINE GOES IN CASE FOR TRAVEL

EASY to take along on a trip, a portable electric sewing machine produced by a German designer is so compact that it can be tucked within a hand bag as shown above. At the traveler's destination, it has only to be lifted out, set on a table, and plugged into the nearest electric-outlet socket to be ready for use.

EGGS ARE GRADED BY ELECTRIC EYE

Eggs are swiftly and accurately graded by an electric eye, in an ingenious new machine that simulates the conventional "candling" test. When an egg is placed in position on the device, light from a thirty-watt bulb passes through it to a photo-electric cell. The amount of light transmitted grades the egg, as is indicated upon a meter dial. Tests in competition with expert candlers have shown the machine to be the more accurate.



A photo-electric cell "candles" eggs and shows results on a dial

NEED CARBON DIOXIDE

ALTHOUGH commonly looked upon as nothing but a waste product, carbon dioxide is almost as essential as oxygen to the human body, according to Professor Yandell Henderson of Yale University. He reports that it stimulates circulation and respiration.

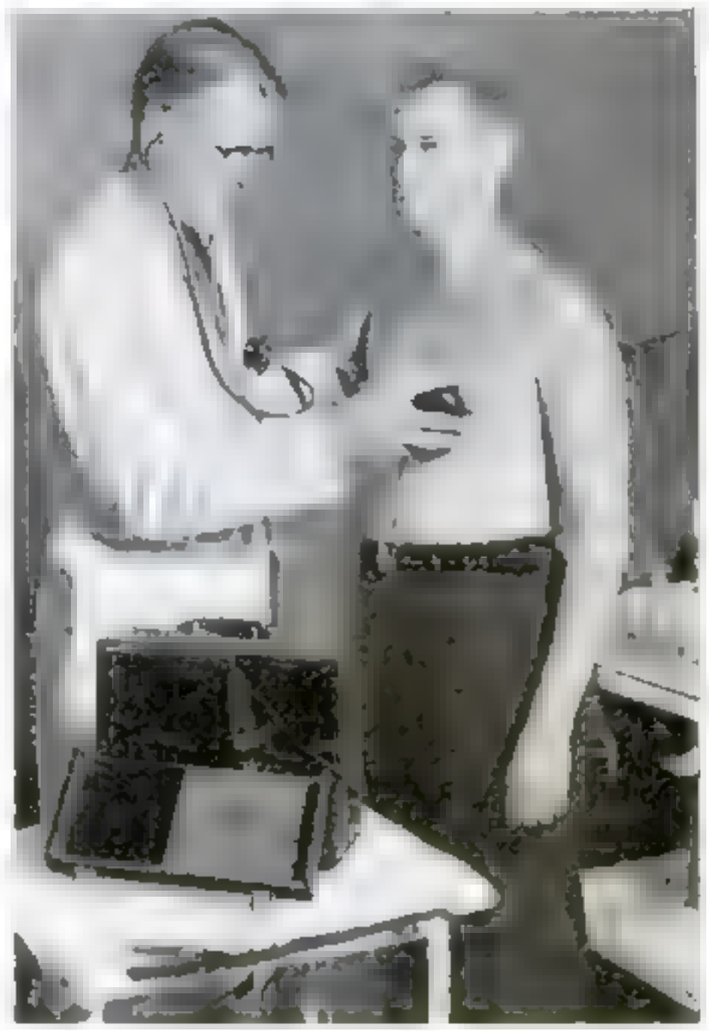
Left, diver poised for a 2½-somersault dive. Above, pattern traced by lights on cap, waist, and ankle

LIGHTS TRACE RECORD OF FANCY DIVES

DUTCH women divers practicing for Olympic competition use a novel training device. Three flash lights are strapped to each diver, one over the ear, one on the hip, and one on the ankle. A practice dive, executed in a darkened indoor pool, is photographed as a time exposure with a still camera. In the developed print, the flash lights show every phase of the dive in a pattern of white lines, as indicated in the picture of a somersault dive illustrated above. By analyzing the lines, errors and faults in the execution of the dive can easily be detected. The system is said to make elimination of minor mistakes much easier for the diver, as they can "see" their movements, and is of great value to the coach as it provides him with a chart whereby he can give his protegees "blackboard" instruction.

ELECTRIC STETHOSCOPE AMPLIFIES HEARTBEATS

DIAGNOSING heart and lung ailments is made easier for doctors by a new electric stethoscope which magnifies heartbeats and other chest sounds. Internal vibrations, picked up by a magnetic diaphragm held against the patient's chest, are magnified by a two-stage amplifier and reproduced in an earphone. A conventional stethoscope attached to the phone cap conveys the amplified sounds to the ears of the doctor. The instrument is equipped with a rheostat for controlling sound volume. Dual outlets permit two physicians to "listen in" at the same time.



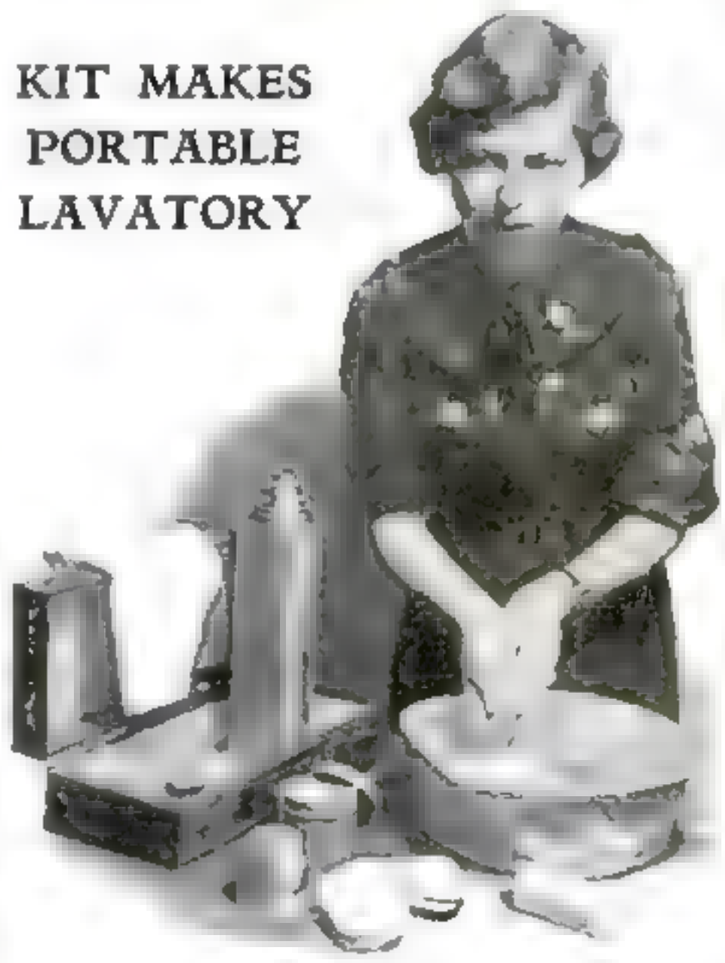
Magnetic diaphragm picks up sounds from chest

BUBBLE SEXTANT AIDS PLANE PILOTS

Special sextant for taking observations from plane

NEW SAFETY for air passengers is made possible by improved types of sextants, designed especially for airplane navigation. One of the latest models, illustrated at the left, provides a self-contained artificial horizon in the form of a liquid bubble, which may be illuminated by a light within the handle. Observations of the altitude of the sun, moon, and stars above the horizon are quickly made by twirling a thumb wheel, operating a worm-and-gear mechanism that replaces the graduated arc of the conventional sextant. The reading is shown in figures on counter drums, and may be recorded on a ground-glass "slate" beside the eyepiece.

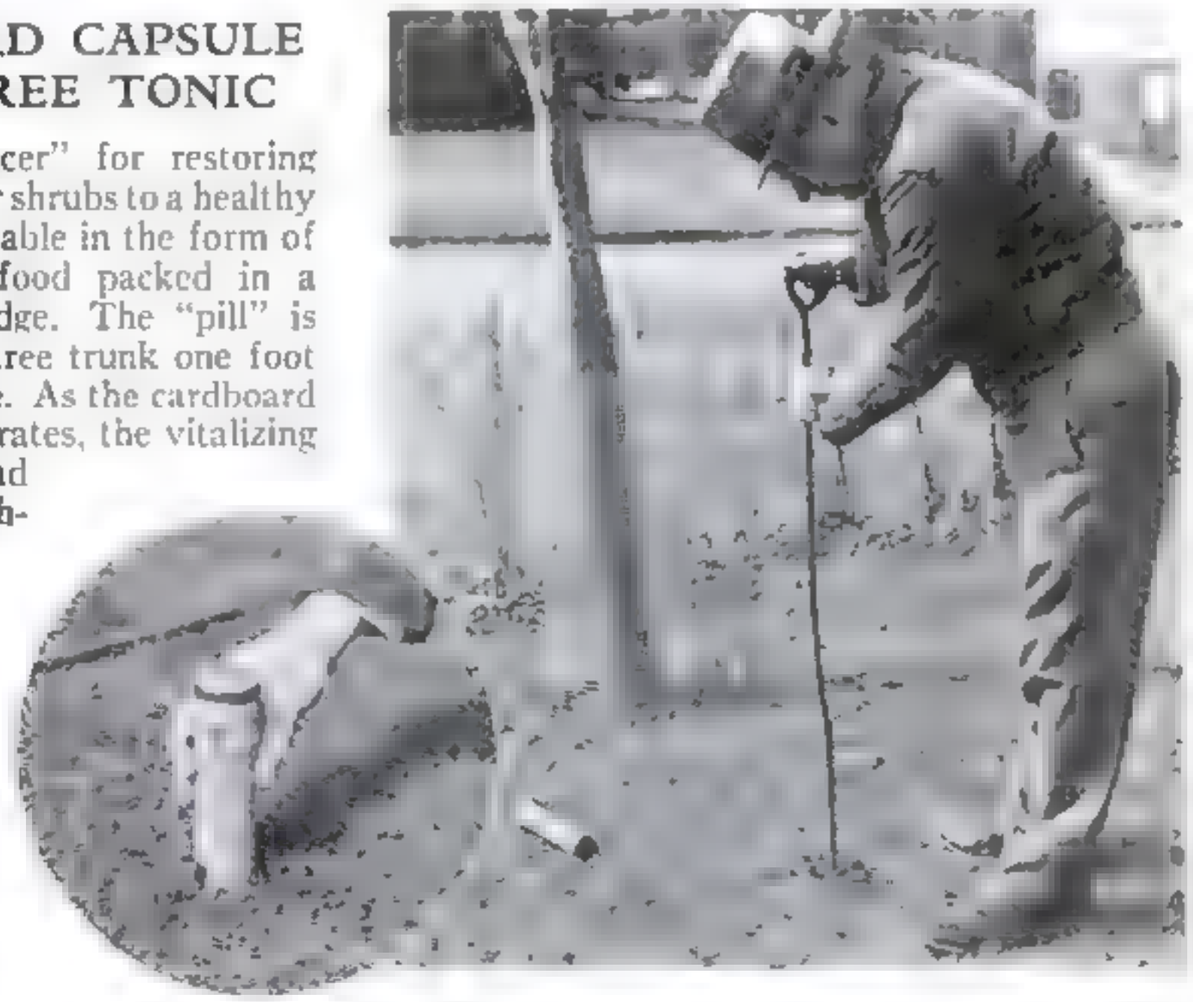
KIT MAKES PORTABLE LAVATORY



MOTORISTS compelled to change tires or make emergency engine repairs on the road will find a novel auto kit useful for washing soiled hands. Compactly stowed in a small suit case, the outfit consists of soap, a scrub brush, a vacuum bottle for hot water, and a collapsible rubber wash basin. The kit is also handy for general use on camping trips; the basin can be used for filling the car radiator with water.

CARDBOARD CAPSULE HOLDS TREE TONIC

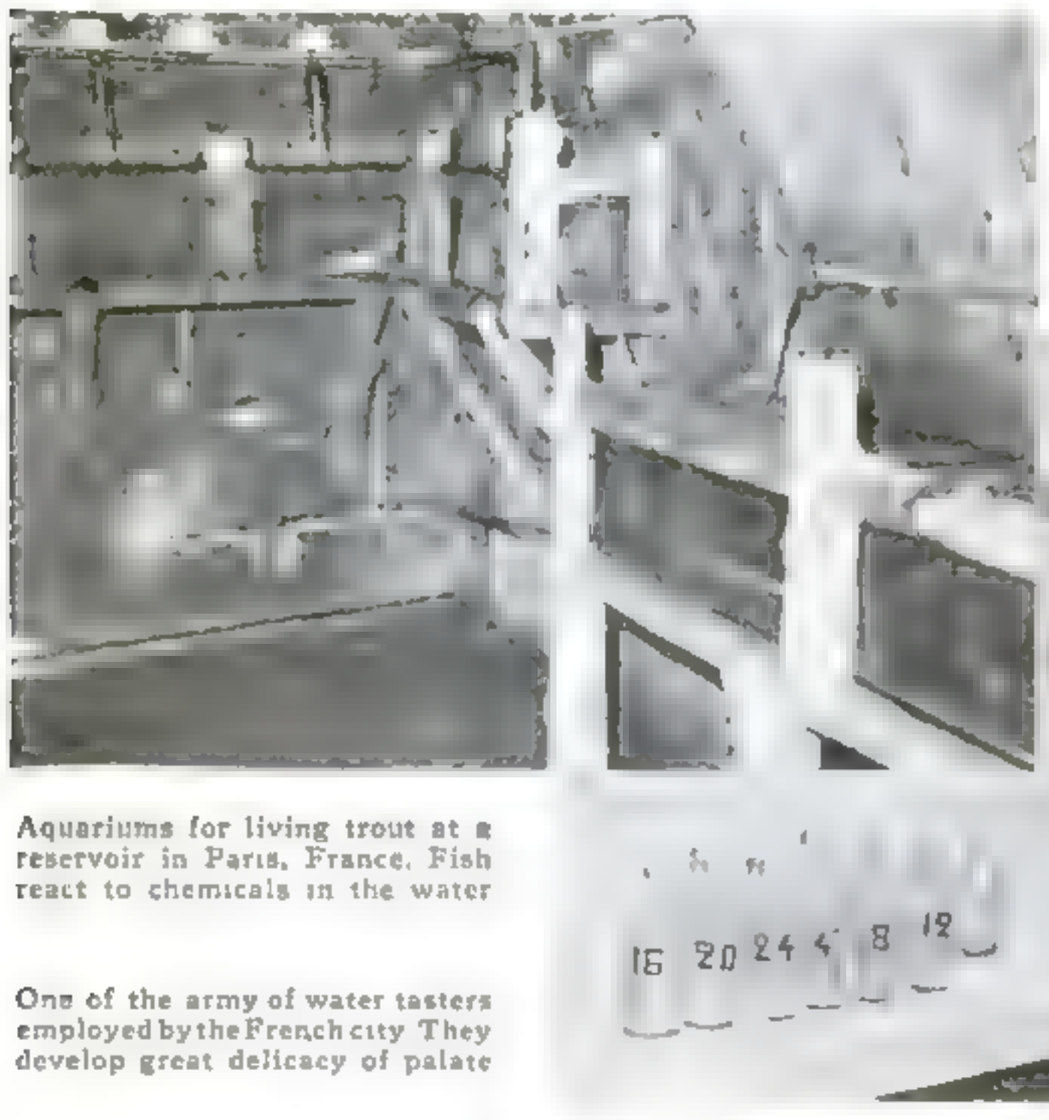
A TONIC "bracer" for restoring weakened trees or shrubs to a healthy state is now available in the form of chemical plant food packed in a cardboard cartridge. The "pill" is buried near the tree trunk one foot below the surface. As the cardboard covering disintegrates, the vitalizing chemicals spread gradually throughout the soil.



Buried near an ailing tree, this cardboard cartridge disintegrates, releasing vitalizing chemicals in the soil

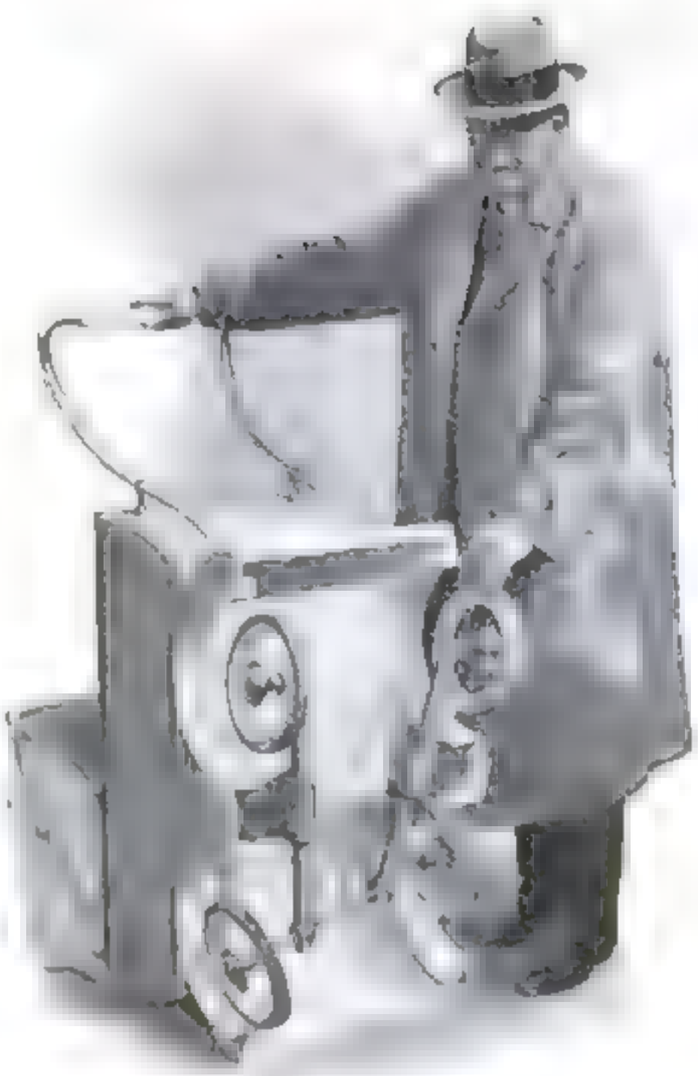
TASTERS AND TROUT TEST PARIS WATER

PROFESSIONAL water tasters share with living trout the responsibility of guarding the water supply of Paris, France. A large corps of these experts is on duty day and night, continually sampling water from the various reservoirs to make sure that the chemicals used in purifying it have not affected its taste. Selected for their posts by rigorous tests, they develop an amazing delicacy of palate. If a suspicious taste or smell is detected in the water from one of the reservoirs, its distribution is suspended until chemists have had time to analyze a sample. The judgment of the tasters is verified, in many cases, by living trout that are kept in aquariums fed by the water supply at the reservoirs. Peculiarly sensitive to the chloride used for purification of the water supplied to the large population of Paris, the fish reveal the presence of an excessive amount of the chemical, often at the cost of their lives.



Aquariums for living trout at a reservoir in Paris, France. Fish react to chemicals in the water

One of the army of water tasters employed by the French city They develop great delicacy of palate



SELF-STEERING PRAM TAKES CORNERS EASILY

TO MAKE a baby perambulator easy to wheel around corners, a German engineer has designed the novel undercarriage illustrated. When the pushing handle is swung to one side, the front wheels automatically turn in the opposite direction. The jointed assembly swings freely upon a pair of pivots attached to the body, yielding to the slightest touch.

FOLDING GOAL POSTS FOIL FOOTBALL FANS

COLLAPSIBLE metal goal posts, designed to foil jubilant souvenir seekers at football games, have been perfected by two former New York University players. The top half of each upright telescopes into the bottom; together with the detachable crossbar, they fold into a shallow, metal-lined trench where they are locked in by a hinged metal cover.

Goal posts being stowed in a trough to keep students from carrying them away as trophies

The posts set up. The top half of each upright telescopes into the lower section for storage

Soldering iron in novel heater. Weight keeps bit against carbons

TRANSFORMER HEATS IRON FOR SOLDER

SOLDERING irons used in electrical classes of the Sacramento, Calif., High School are heated between carbon electrodes connected to the secondary coil of a step-down transformer designed by the instructor, R. J. Springall. Resistance between the carbons and the copper of the iron heats a half-pound tool in less than a minute.

WEATHERPROOF GARDEN LABELS KEEP MARKINGS LEGIBLE

FLOWER or plant names marked with lead pencil will not fade from specially prepared garden labels that have been chemically treated by a new process. Although the marks can be removed with an eraser, they are said to remain clear and legible regardless of the action of the weather.

PURSE CONCEALS CAMERA FOR SECRET SNAPSHOTS

HIDDEN within a bronze holder attached near the clasp of a woman's purse, a tiny "candid camera" may be operated secretly to snap unposed photographs while the purse is held unobtrusively in the lap or against the body. For less furtive shots, the purse can be held at eye level and the camera trained on the subject through a small, collapsible view finder. Equipped with a high-speed lens, the instrument uses standard thirty-five-millimeter movie-camera film.

WOULD ADD TO ALPHABET

AN ALPHABET of forty-one letters would be an improvement over our present one of twenty-six, according to a Portland, Ore., educator. In the English language the letter "a" alone is pronounced eight different ways. He would add a new letter for each sound. With such an alphabet, he declares, a person unacquainted with the language would require only two weeks' time to learn it.

Strips of transparent material form the bag of this balloon, shown being inflated for a test

STRATOSPHERE BALLOON IS MADE OF TRANSPARENT MATERIAL

TO STUDY cosmic rays in the stratosphere, Philadelphia scientists recently assembled a balloon made entirely of transparent paperlike material. Overlapping sections, were glued together to form the pear-shaped bag, which will carry aloft a gondola containing a cosmic-ray machine. A short-wave radio transmitter will automatically broadcast its recordings.

TOURIST CAMP HAS CONCRETE "TEPEES"

CLEVERLY constructed to look like a small Indian village, a novel tourist camp near Lawrence, Kans., has concrete shelters closely resembling Indan tepees. Cement stucco, laid over wire mesh on a foundation of three slanting poles, forms the walls of the odd overnight cabins. Each "tepee" is equipped with comfortable beds, running hot and cold water, cooking stove, and other conveniences.

Concrete "tepees" give this auto camp the look of an Indian village

Dr. Robley D. Evans demonstrating his radium detector

SHOWS RADIUM IN THE BODY

BEFORE any symptoms of poisoning are apparent, an ultrasensitive radium detector developed by Dr. Robley D. Evans, of the Massachusetts Institute of Technology, shows the metal's presence within the body. An electrode, attached to the electrically operated device and held near the patient, detects radium radiations even in extremely minute quantities. In one case, the instrument discovered the presence of radium where the best conventional methods now in use had failed to reveal the slightest trace.

New airplane altimeter that indicates height above the ground

PLANES GET MAGNETIC ALTIMETER

A NEW airplane altimeter, invented by an Albany, N. Y., scientist, is soon to be submitted to U. S. Navy officials for preliminary tests. The device is designed to indicate the height of a plane in relation to the ground directly beneath it, rather than the height above sea level as in conventional altimeters. Although the operating details of the instrument have not been disclosed, it is known to operate on magnetic principles. The inventor expects that the altimeter will prove invaluable in bad-weather flying over treacherous mountain ranges, when exact knowledge of the plane's height above the ground is of vital importance to the pilot depending solely on his instruments.

AN EXPERT TELLS HOW TO TAKE CARE OF YOUR

Fishing Tackle

By Roy L. Haslett

TAKING DOWN A FLY ROD

The tip of the rod should be unjointed first. Extend one hand above the head to grasp the upper joint, and pull the lower joint with the other hand. Below is a lambskin case to protect the reel

NO TWO anglers fish exactly alike, yet all who get the most out of this sport have one trait in common: they keep their equipment in tiptop condition. By doing so, they avoid many backaches and heartaches while whipping mountain streams, trolling in the deep water of inland lakes, or casting into the surf along our two oceans; they also avoid the necessity of nerve-trying repair jobs at a time when they should be enjoying the precious hours of an outing.

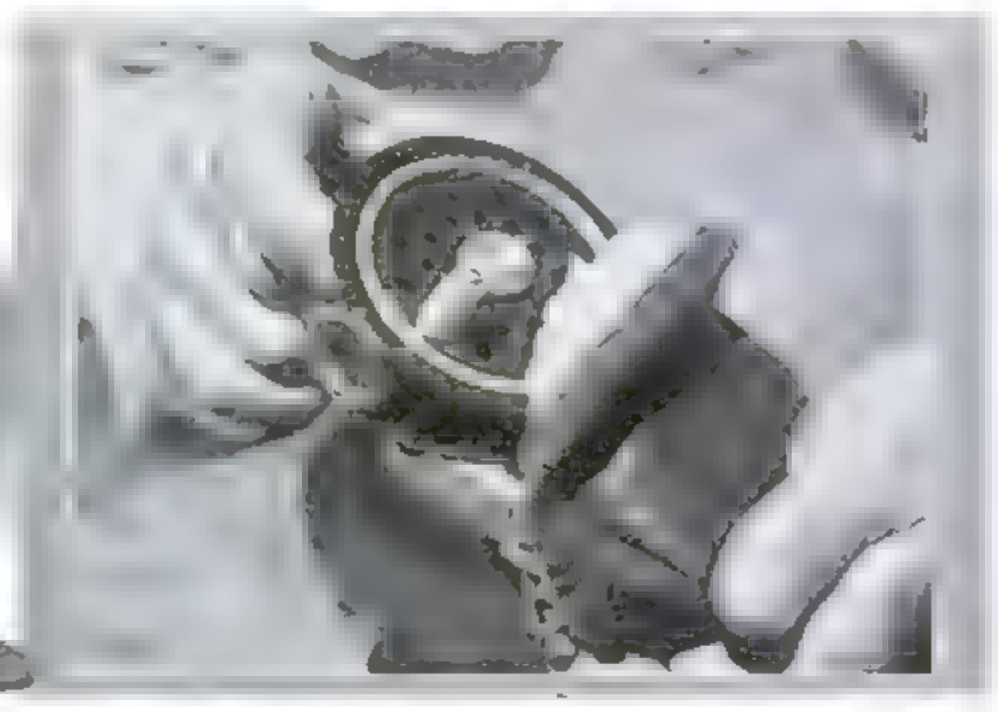
From Los Angeles to Seattle and across the continent, I have observed many anglers trying their luck with gummy reels, bowed rods, frayed lines, leaders that hung by a strand, rusty hooks and dingy plugs, and flies which had lost all semblance of form. Such fish as these people caught came to them largely through luck, whereas in many cases proper attention to their "angling tools" would have enabled them to land many more fish and get more real enjoyment out of the sport.

Care of equipment largely begins and ends on the actual fishing trip. Daily attention in the field makes off-season care unnecessary, excepting on the day when you put away your equipment for the winter. By exercising a little ingenuity and observing a few rules, you can keep your rods and tackle in perfect repair.

The trout fisherman would do well to purchase a coat equipped with proper pockets, and rather short in length so it will not dip into the water while wading. He should have pockets to carry his leader case, his fly box or books, lunch, and such other equipment as may be necessary.

Bass fishermen should have proper kit boxes with compartments for correct complements of bass plugs and lures. These kits also contain spaces for reels, cases, emergency tools, and spares. The ocean fisherman should have a kit box with compartments for his reels, wire leaders, pliers, and such artificial lures as he might use.

Both fresh-water and salt-water tackle boxes should be given several coats of lacquer when new to protect them against rust and corrosion. An adequate outfit for a trout fisherman includes two rods, one for heavier fishing, by which I refer to the cast rather than the weight of the fish to be caught, and a lighter outfit for "close-in" angling. You may compensate for the length of the rod and the size of your hook by using as light a leader as your ability and the size of the fish you



expect to catch warrant. Where heavy fish are anticipated, naturally a heavier rod should be used.

Let's assume that you are properly outfitted and ready for the season. What casualties in equipment may you reasonably expect? Too tightly fitting ferrules, broken rods, snapped lines and leaders? How may these be repaired?

Every jointed rod, when sent from the factory, is equipped with ferrules or joints that fit tightly and exactly; care must be exercised to keep them clean. Should the ferrule seem to stick, do not make the mistake of scraping it with an abrasive, for this is likely to destroy the fit and produce a loose joint. The proper procedure is to clean both the male and the female ferrule thoroughly with soap and water, or rub them perfectly clean with a dry, soft rag. The best method of oiling the ferrule is to rub it in the hair, behind the ear, or alongside the nose. Enough natural oil will be deposited on the metal to lubricate it.

In assembling the rod, care should be used to avoid twisting or turning. Line up the guides much as you would sight a rifle, then seat the ferrule by pushing it in straight.

In taking your fly rod down after the day's fishing, unjoint the tip first. Grasp the tip joint just above the ferrule with one hand, with the arm fully extended above the head, and exert the pull with the other hand, held near the top of the second joint. Never pull with the upper hand, because of the danger of whipping the tip into some obstruction that might break it.

A tight ferrule may be loosened by grasping the rod behind the knees and using the leverage of legs against wrists. Two persons, by exerting a straight pull, can unjoint the most stubborn rod.

Twisting is apt to weaken the bond between the ferrule and the bamboo. In case the ferrule is slightly loose on the rod, a temporary repair can be made by heating the ferrule with a match to soften and reseat the cement. If there is a loose fit between the male and female ferrules, a piece of beeswax will solve the problem. Rub the beeswax lightly on the male ferrule and it will be found that the seat will be tighter. If difficulty is experienced in disjointing a ferrule where beeswax is used, a lighted match applied to the ferrule will cause the wax to soften.

In the event of breakage of a fly-rod tip or the light tip of a bass casting rod, a very effective and permanent repair can be made if the fracture is not a clean break. Apply a good-quality glue to the break and adjust it so that all parts of the wood are in contact, leaving no protruding splinters. Split a quill toothpick or goose quill and trim it so that it will not quite meet when placed around the break. Place the quill over the glued break and wrap it securely with common wrapping twine. Be sure the repaired section is straight.

After allowing ample time for the glue to dry, remove the wrapping string, sandpaper the repaired portion, and wrap it solidly with No. 00 white silk thread. When varnished, the repair will hardly be noticeable. If repaired properly, the fractured tip will be as strong as originally.

Care of the newly developed tubular-steel fly and bait-casting rods is important to insure long life. Dry them thoroughly and wipe carefully with an oiled cloth after each day's fishing.

If a bamboo fly rod or light bait-casting rod develops a set, the following method can be used to correct it, although it is not recommended as a permanent repair: Pass the bent joint back and forth carefully over a gas flame until it is thoroughly warm, then work it slowly back into shape. This will effect a realignment of the splines. In *(Continued on page 82)*

A line drier in use. Wet line should never be left on the reel overnight

In assembling the rod, make sure that the guides are in line before seating the ferrules. This is done by sighting, as below

For between-seasons storage, line may be stripped loosely into the bottom of a cardboard box and covered with a perforated top to permit circulation of air

The upper picture shows how to mend a broken tip by using a split goose quill as a splint. Above, a loop of thread laid under a wrapping for pulling the end under to make it fast

The barrel knot, demonstrated at the left with a piece of rope, is useful in repairing leaders

TANK SHIPS...Perpetual

A tanker taking on her liquid cargo. Through these huge flexible hoses as much as 10,050 barrels of black oil flows in an hour

Below, a heavily laden ship of the oil fleet putting out to sea. The funnel at the stern serves as an "air anchor" to hold the bow into the wind in a storm

By ANDREW R. BOONE

PLOWING through the seven seas, some 430 American oil tankers are at this moment delivering a half billion barrels of crude and refined oils to American and foreign markets. Together with foreign bottoms, making up a world fleet of 1,500 seagoing oil drums, these sturdy ships engage in the hugest and most hazardous of shipping enterprises

Oil tankers are constructed like no other ships afloat, and resemble no others in operation. While their job is potentially the most dangerous on the seas, because they carry inflammable cargoes and sail, regardless of storm warnings, into the teeth of storms and hurricanes, fire and heavy weather take remarkably few tolls of ships and crews

Their destinies rest in the hands of a small group of men on the Atlantic and Pacific coasts, dispatchers who carry in their minds complete knowledge of the several fleets. One man may be responsible for as many as twenty tankers. He knows what each is carrying, how she is carrying her cargo, the size of individual tanks, details of construction and her discharging speed

The dispatcher must keep his fleet on the move, for the earnings of possibly $30,000,000 worth of tankers, carrying $3,000,000 worth of oil, depends upon keeping them at sea. Because they spend nine tenths of their time out of port, tankers are known as the perpetual-motion machines of the high seas. Their crews seldom know a holiday, excepting those brief periods of ten to twenty hours when the vessels are discharging or loading their liquid cargo.

How do the tankers operate, and how are they kept safe against fire, explosion, and collision?

Suppose we look in on a dispatcher, high in a Los Angeles office building. Before him is a map showing the locations of fourteen tankers, each carrying from 80,000 to 100,000 barrels of oil. These ships are scattered from points off the New England coast to China. Yet he knows, within a few miles, the exact position of each

The dispatcher's big job comes in shuffling cargoes for delivery at possibly fifty ports. One ship may carry seven grades of refined oils—gasoline

Crew members demonstrating tests made during loading. Left to right, they are taking temperature of oil, gauging depth in tanks, shutting off flow at valve, and determining the specific gravity

Motion Machines *of the* Sea

naphtha, kerosene, benzine, Diesel, and fuel oils—while another will have in her tanks three grades of crude. A single ship may sail from a New Jersey refinery to a half dozen African ports, dropping several thousand barrels of oil at each. Excepting a few tramp steamers, tankers return empty to loading docks, near refineries or oil fields, because of the difficulty of cleaning out alien cargoes.

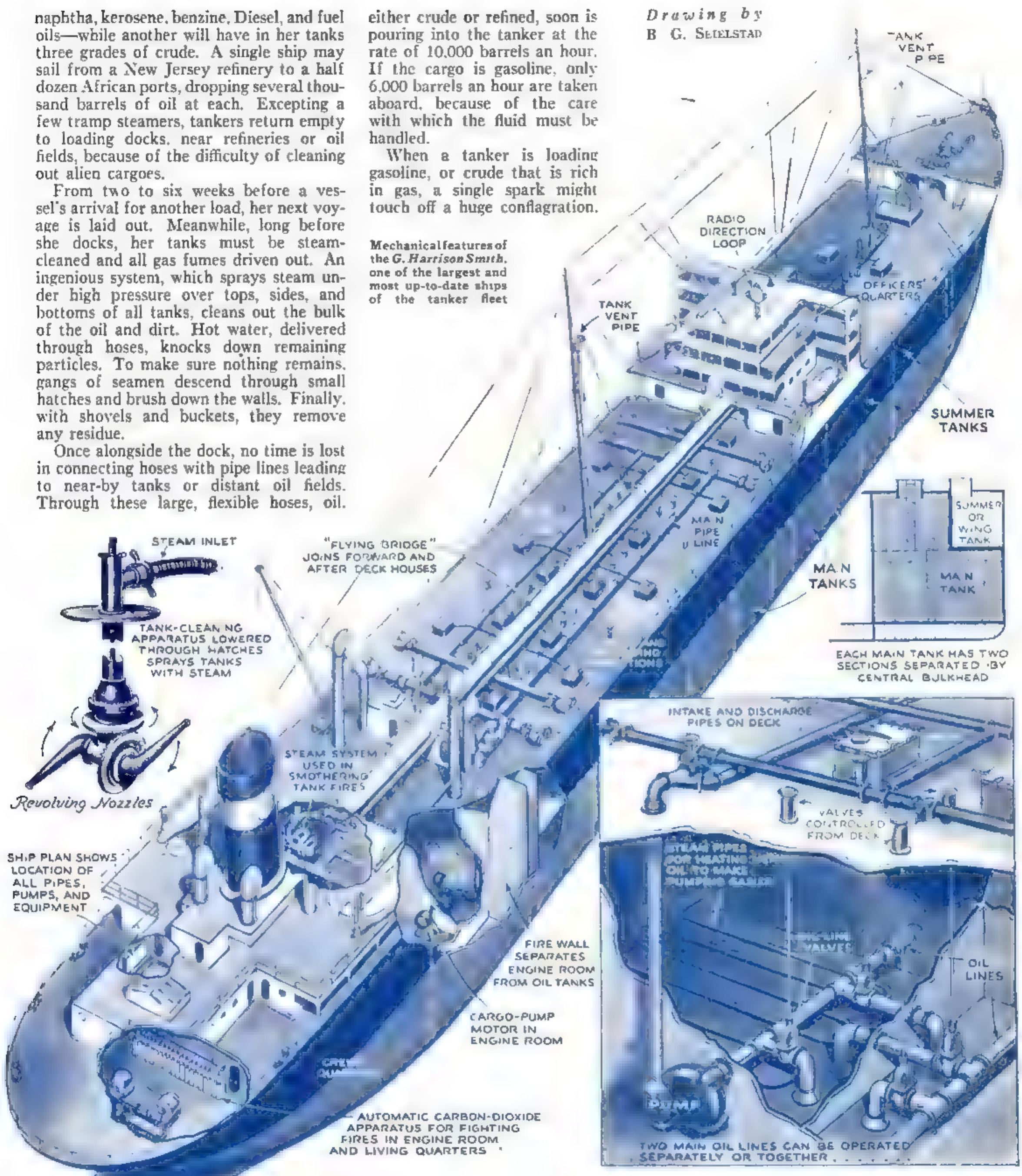
From two to six weeks before a vessel's arrival for another load, her next voyage is laid out. Meanwhile, long before she docks, her tanks must be steam-cleaned and all gas fumes driven out. An ingenious system, which sprays steam under high pressure over tops, sides, and bottoms of all tanks, cleans out the bulk of the oil and dirt. Hot water, delivered through hoses, knocks down remaining particles. To make sure nothing remains, gangs of seamen descend through small hatches and brush down the walls. Finally, with shovels and buckets, they remove any residue.

Once alongside the dock, no time is lost in connecting hoses with pipe lines leading to near-by tanks or distant oil fields. Through these large, flexible hoses, oil, either crude or refined, soon is pouring into the tanker at the rate of 10,000 barrels an hour. If the cargo is gasoline, only 6,000 barrels an hour are taken aboard, because of the care with which the fluid must be handled.

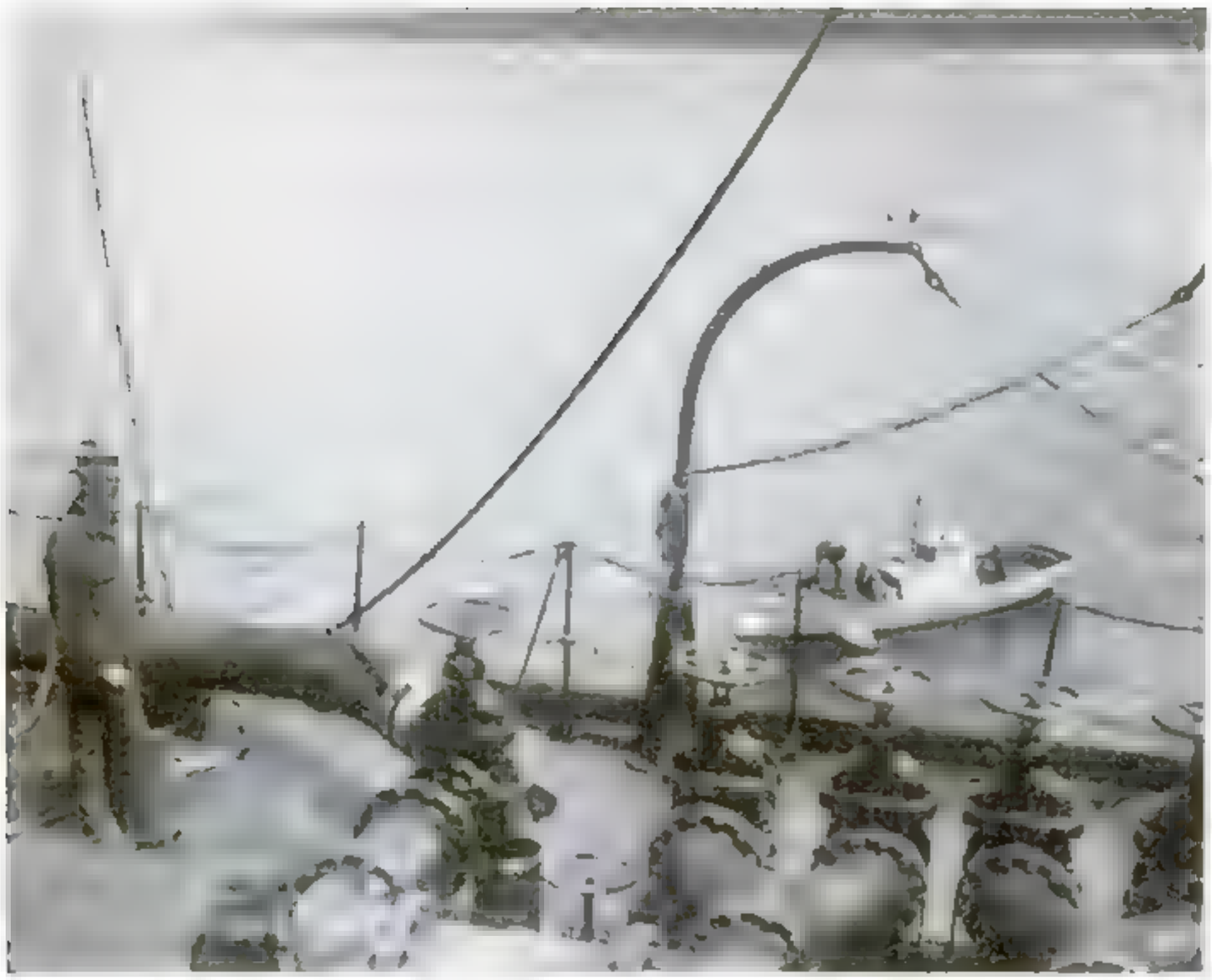
When a tanker is loading gasoline, or crude that is rich in gas, a single spark might touch off a huge conflagration.

Drawing by
B. G. SEIELSTAD

Mechanical features of the *G. Harrison Smith*, one of the largest and most up-to-date ships of the tanker fleet



SHUTTLING BACK AND FORTH ACROSS THE SEVEN SEAS, VESSELS OF THE OIL FLEET CARRY THEIR DANGEROUS CARGOES INTO THE TEETH OF STORMS AND HURRICANES



A view from the deck of an oil ship as men on a launch uncoil the telephone-line connection from its buoy at the end of sea pipe line, for communication with the refinery

Tankers sometimes take on oil far from shore, receiving their cargo from a submarine pipe line. Below are two of the five anchors, each weighing eight tons, that hold the vessel in position

Elaborate precautions are taken to insure safety. Only absolutely essential repair work may be undertaken—and that with nonsparking tools. Hammers, buckets, and wrenches used in such work are made of bronze. All hatches, excepting those leading to tanks being loaded, are battened down and locked. Yet, occasionally, some one slips, and fire or explosion—or a terrible combination of both—results.

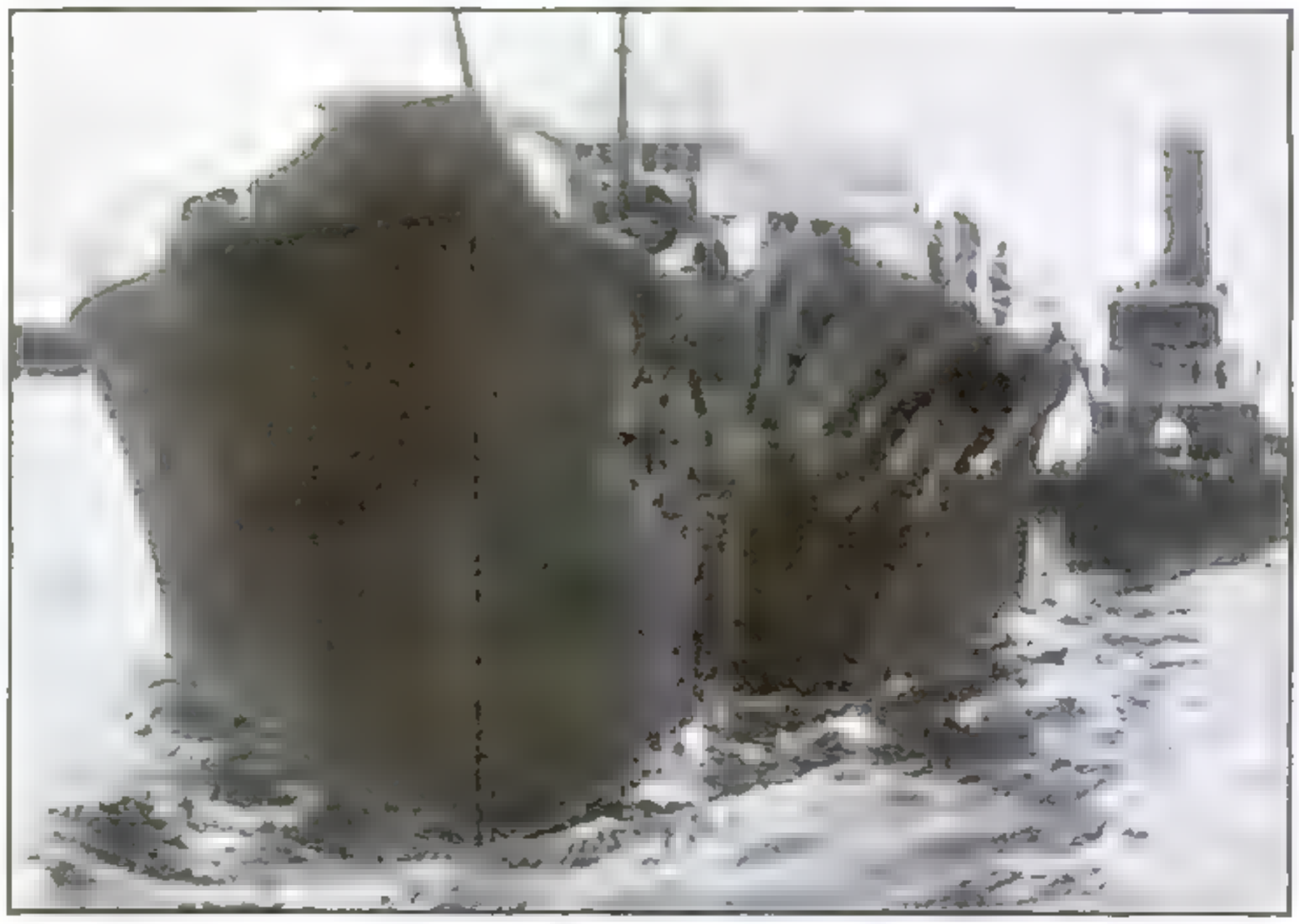
While discharging high-test gasoline at a San Francisco pier, the *Charlie Watson* exploded without warning, killing three men and seriously injuring nine. Fire and smoke rose higher than the masts on the first blast, enveloping the entire midship section in flames. The cause, while never definitely determined, came from one of two sources: gasoline sprayed from a broken delivery hose onto an electric motor, or a workman wielding a hammer which struck a spark. A second explosion hurled fifty would-be rescuers off the ship onto the pier. So great was the heat that no one could approach the burning vessel, yet fire apparatus curbed the conflagration in twenty minutes.

The *Kekoskee*, with 14,000 barrels of oil in her tanks, was fueling the U.S.S. *Surveyor* at a Seattle pier when an explosion on the dock showered the ship with flaming oil. Chief Officer Martin Hansen, on watch, ordered the lines broken and, with the tanker a roaring furnace, ran out into Puget Sound. Others of the crew raced to the engine room and quickly generated steam. Her forward works ablaze mast high, the *Kekoskee* seemed doomed. But speedy work soon sent showers of steam over the hot plates, and the fire was quenched before the hull could burst. Quick action saved not only these two vessels, but also the Dollar liner *President Pierce* and two other ships that were working cargo at near-by berths.

Newer ships are considered virtually fireproof, insofar as destructive conflagration is concerned, despite their inflammable cargoes, for automatic carbon-dioxide systems stand ready at the tiniest blaze to spread a suffocating blanket of the gas in all main tanks, summer tanks, pump rooms, engine room, paint and oil lockers, storeroom hold, and forepeak. Remote controls are provided forward, amidships, and aft.

As the levels rise in the many tanks, frequent samples are taken, for the fluid must test the same as that on shore. Occasionally a valve sticks, and a tanker reaches its destination with oil of two grades mixed; this necessitates either a forced sale at lower price or a wasted round trip to the refinery for new oil. In twelve to fifteen hours, even the largest tanker is loaded and ready for the sea. Unlike other cargo boats, it has no grimy gangs of stevedores trucking boxes and bales into the holds. At the outset, the ship's pipe-line system is connected with the shore pipes, valves are opened, and the oil, either forced in by pumps or flowing by gravity, fills the tanks.

When, finally, the full cargo has been measured and the pumps silenced, hatches are battened down. In gasoline-carrying tankers, gas from the engines—flue gas, it is called—is pumped into the tanks, thus shutting out free air and reducing the danger of a stray spark starting a destructive fire. At *(Continued on page 111)*



The tanker *W. W. Bruce* as she appeared after a collision with another vessel. In spite of their dangerous cargoes, the oil carriers sail through all kinds of weather with remarkably few mishaps

Clinic FOR Motorists

This brake-reaction test, one of a series installed at the New York Museum of Science and Industry to gauge driving skill, measures the time it takes a subject to shift his foot from accelerator to brake when a red light or a picture of a boy falling off a bicycle flashes on

HOW MUCH GLARE CAN YOU STAND?

Peering into a viewing box, the subject sees the figure of a pedestrian against the lights of an oncoming model automobile, as shown in the inset. By varying the illumination on the figure, it is possible to determine how many units of light the motorist needs in his own lamps for safety

To measure keenness of hearing, a driver jots down numbers he hears through earphones, the sounds becoming progressively fainter. Uniformity is assured by the use of a phonograph to produce the sounds

Judgment of speed and distance is gauged by having the driver estimate the point, represented by a number on the scale at the right, where one model car will come abreast of another, slower-moving one. The average driver's guess is wrong by two units

With a realistic steering wheel, the motorist tries to keep the image of a radiator cap in the center of a "road" painted on a background which moves constantly as actuated by an eccentric cam. A dial registers the driver's ability to stay on the "road"

In the Ishihara test for color-blindness, the subject tries to identify disks by numerals outlined in dots of one color on a background made up of splotches of color in a variety of shades

Weird Schemes To Make It RAIN ...but they never work

Because of the popular belief that heavy rains follow big battles, cannons have been fired in efforts to produce showers

By
ROBERT E. MARTIN

CHILLING the winds with giant refrigerating coils! Bombarding storm clouds with long-range siege guns! Churning the air with airplane propellers!

These are but a few of the hundreds of strange and curious schemes that have been devised to wheedle rain from an unwilling sky. Each year brings its crop of weird plans to combat drought and produce rain when and where it is needed. Some are based on scientific fact, many have never passed the "paper" stage, and others are the fantastic ideas of professional "weather makers," who even today are able to find credulous customers to pay them for their services.

Just a few months ago, a French inventor proposed, in all seriousness, that rain could be produced by erecting a 2,000-foot-high, cone-shaped "meteorological tube" beside an ocean bay. Leaning concrete struts, according to his plan, would support the narrow base of the hollow tube so that it would overhang the water. At its flaring upper end, giant wind vanes, whirled by ocean breezes, would suck aloft the moisture-laden air from the surface of the water. As the air reached the upper level, so the inventor maintains, it would expand and cool, condensing the moisture to form a copious shower.

Variations of this idea, advanced in countless forms, have been suited to the times in which they appeared. One inventor of an earlier era advocated erecting a tall chimney over a pool of water and building fires around the pool's edge, to carry moisture aloft and form rain clouds. A more recent schemer envisions making rain by arranging a squadron of airplanes in a circle, facing away from the center, with tails up and propellers spinning at full speed to create artificially the ascending air currents that precede a natural rainstorm.

To some, the idea of a ring of airplanes with heads out, like musk oxen on the defensive, may make a ludicrous picture.

Other ideas of would-be rain makers may likewise be greeted with more levity than they deserve. Impractical as they may be, however, each of the ideas so far mentioned has at least some shred of scientific theory to bolster it up.

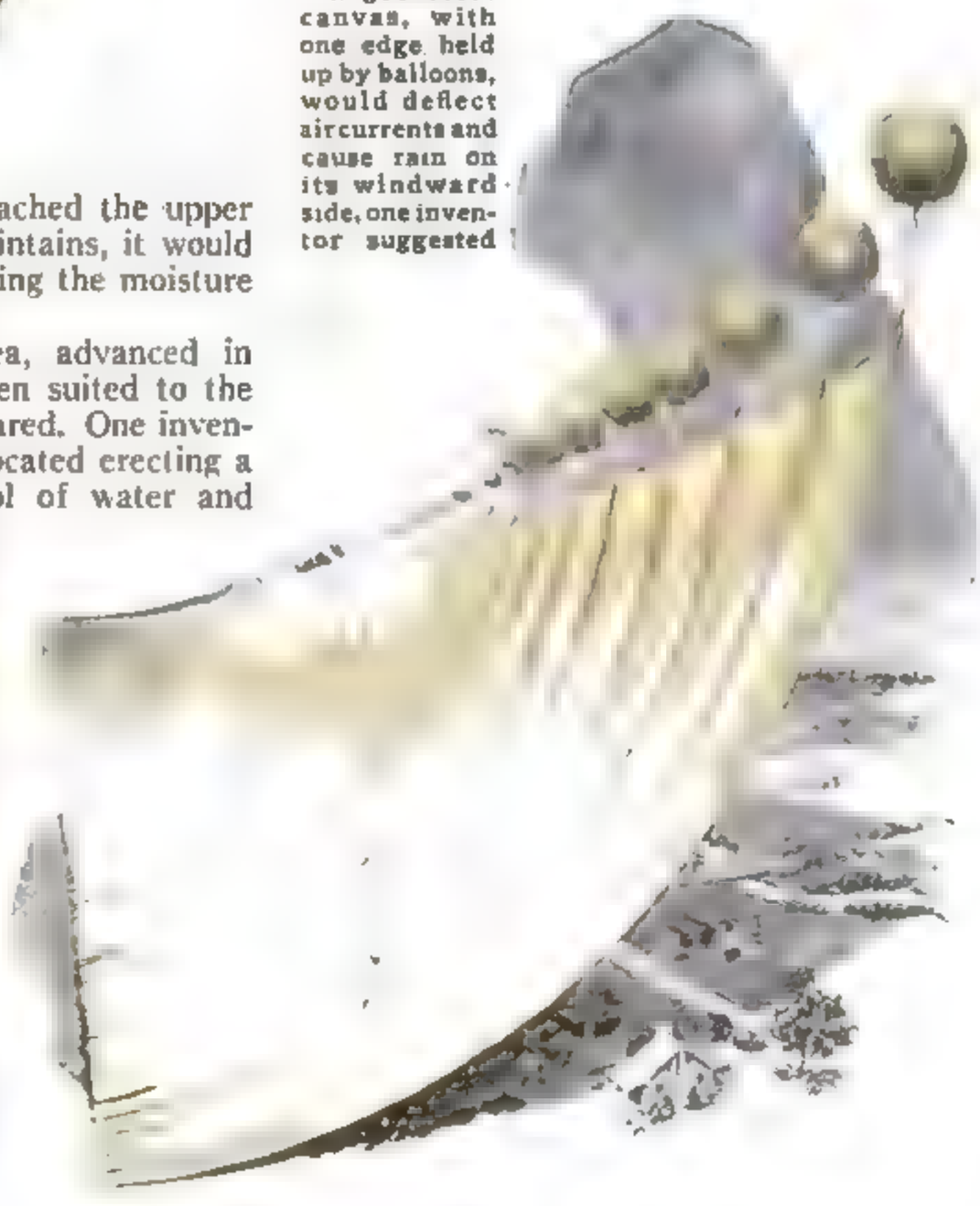
The hitch appears, not in the theory, but in finding a practical way to carry out such an enormous undertaking. The airplane-propeller idea, for example, is like trying to lift a towering skyscraper with an auto jack. Its principle is sound, but the apparatus simply isn't large-scale enough to be effective.

No objection could be made to the plan of one amateur weather maker on this ground, at least—for he urged the Government to build an artificial mountain 100 miles long and 5,000 feet high! The sloping side of this gigantic lean-to would deflect horizontal winds upward and shower rain on the windward side just as a real mountain does, he maintained. So would a large sheet of canvas supported by balloons, as another inventor proposed.

Discarding any roundabout way of chilling air to extract its moisture, an adherent of more direct methods favored erecting giant refrigerating coils in the path of humid winds. Just as dew forms upon a pitcher of ice water, so water from the air would collect on the coils. As it ran off, pipes would carry it to irrigation reservoirs and thence to sun-baked fields. Basically, the idea is sound, but under average conditions the annual cost of irrigation with the "cold-coil" plan would be about $20,000 an acre.

Another plan patented some years ago would have cost even more. Batteries of cannons were to bombard the sky with

A huge sheet of canvas, with one edge held up by balloons, would deflect aircurrents and cause rain on its windward side, one inventor suggested



shells filled with carbon dioxide gas. Dynamite and time fuses would explode the shells at a predetermined height. The carbon dioxide, chilled as it expanded, would evaporate into a sheet of low-temperature vapor, cooling the surrounding air in turn and precipitating rain. A California scientist did a bit of figuring on this plan. Counting only the price of the gas itself, the cost of treating a single acre of land to a quarter inch of rainfall would be about $600,000.

Rain-making schemes of another brand approach the purely fantastic, even in theory. One inventor proposed to send aloft, successively, four fleets of balloons. The first, by exploding charges of gunpowder, would scatter particles of chlorate of potash through the air; the second, a spray of water; the third, nitrogen gas; and the fourth, steam. Rain would surely follow, he declared, within twenty-four hours. Just why he expected this happy outcome remains a mystery.

Another balloon enthusiast patented a gas bag covered with metal spurs, which were to be joined by a wire network surrounding the fabric. The wires led to a cable that tethered the "lightning-rod balloon" to the ground. When this extraordinary device was allowed to rise into an electrically charged cloud, its designer argued, the discharge of electricity to the ground through the cable would release raindrops from the cloud.

By far the greatest number of plans for producing rain have been based on the popular, and mistaken, belief that loud noises or heavy concussions will cause a downpour. Early proponents of the noise theory of rain erroneously believed that the concussion of thunder or artillery fire would jostle together the small droplets of moisture in a cloud, forming larger drops that would fall as rain. One of their leaders, Edward Powers, published in 1871 a book in which he assembled enough supporting evidence to wield tremendous popular influence. The following year, he petitioned Congress to finance an ambitious rain-making experiment, in which 300 cannon were to be taken to an arid section of the West and fired simultaneously.

Congress refused, but by 1891 public pressure became so great that it consented to authorize an elaborate test of the theory.

Odd, indeed, for a grizzled war dog, must have seemed the task assigned to Gen. Robert Dyrenforth, under whose direction the trial was actually carried out near Midland, Tex. Instead of hurling steel at an enemy, his cannon barked defiance at the sky. Shell after shell went screaming aloft. Balloons soared into the air, filled with an explosive mixture of hydrogen and oxygen, and exploded high above the ground as fuses touched them off. One went off squarely in the middle of a black rain cloud—but, like the rest of the skyward volley, to no avail.

Did the Dyrenforth experiments settle the question once and for all, as anyone might have expected? Quite the contrary! As late as 1912, a group bombed storm clouds near Battle Creek, Mich., and cheered when rain shortly arrived. However, as a matter of record, it rained that day over an area extending from the Rocky Mountains to the Atlantic.

Quick to capitalize upon the national interest in rain making aroused by the Dyrenforth tests, a horde of professional "weather wizards" invaded the agricultural regions of the west. Approaching a farmer, one of these self-styled experts would contract to deliver a certain amount of rain within a specified time, for a sizable fee. He was to be paid, the "rain contract" usually stipulated, only in case he made good on his promise.

Thereupon, the "wizard" retired into a windowless shack from which wisps of smoke soon arose, showing that he was at work with his "secret chemicals." Presently he emerged, announcing that he had done his work and rain might now be expected. If nature came to his aid by providing the desired shower, he pocketed his fee and went blithely on his way.

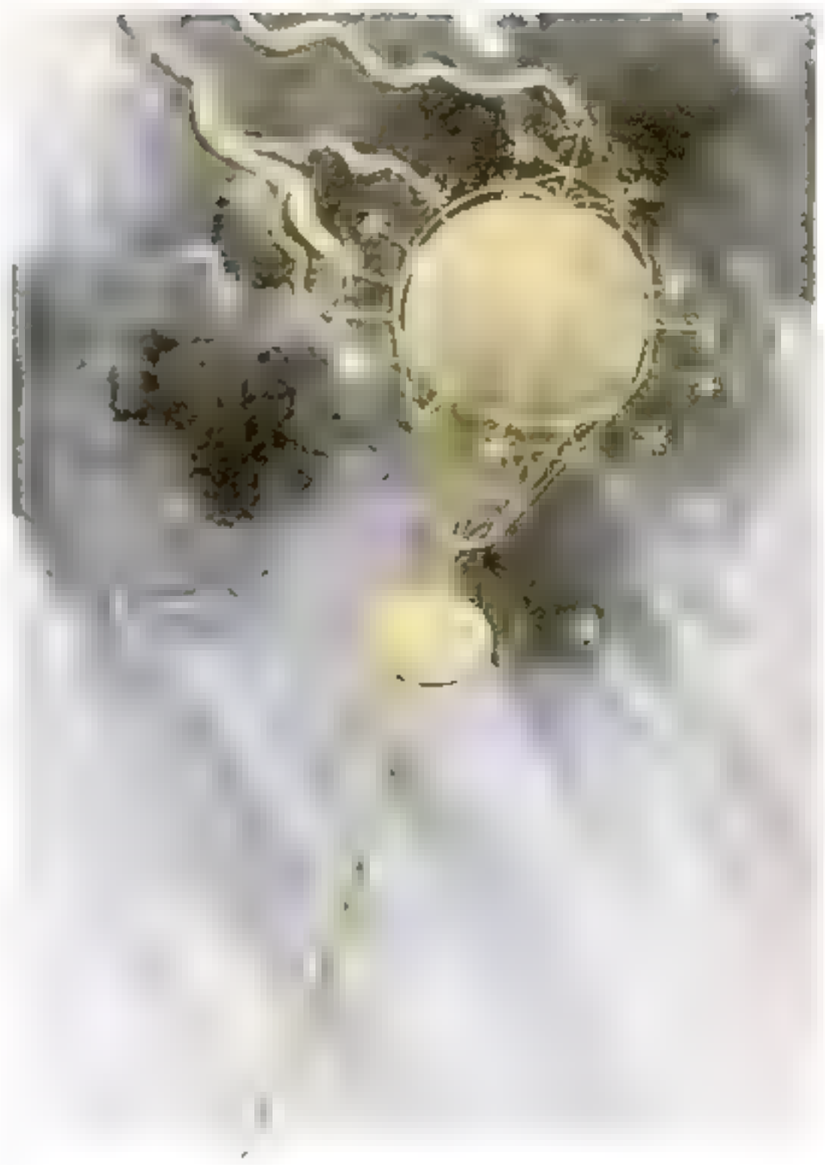
Naturally, a shrewd rain maker took care to consult weather maps and records, attempted his operations only in favorable weather, and never contracted to "produce" more rain than normally fell in a given locality. Thus he had an excellent chance of making good. Should he fail, he had nothing to lose.

One of the most famed of all claimed to bring rain by evaporating "secret chemicals" in tanks mounted on thirty-five-foot towers. This man plied his trade for fifteen years over a territory from central Texas to Alaska. The secret of his success may be judged from his contract with an agricultural association in Medicine Hat, Alberta, Canada, to supply rain over a period of three months at a fee of $1,000 an inch. The official rain gauge at Medicine Hat recorded five inches of rain during that period. But weather records show that the *normal average rainfall* in that section for those three months is more than six inches!

A western railroad hired a man who was said to have broken innumerable dry spells in Australia, and gave him a special car which he fitted with chemicals, water tanks, exhaust pipes, and electric batteries. At intervals along the line, the "rain car" was deposited on a siding. Smoke curled from its exhaust pipes, and presently the "Australian rain wizard" emerged and assured the congregated farmers that, thanks to the generosity of the railroad, rain soon would fall upon their parched fields. Then the rain car was hauled away to another dry spot.

The railroad tour was reported to be "amazingly successful." Follow the rainmaker's route with U. S. Weather Bureau maps, however, and you discover that rain followed his mysterious activities only where the weather was unsettled and where the local Weather Bureau official had definitely predicted rain!

Preventing rain is as easy as producing it, if you would credit the glib sales talk of a professional *(Continued on page 115)*



Another scheme is to send a "lightning-rod balloon" into a cloud to draw off its charge of electricity

A Frenchman now wants to produce rain by building a giant, cone-shaped tube to suck moist ocean air aloft

POWERED SAW ON POLE CUTS TREE BRANCHES

FOREST trees can be quickly pruned with a powered pole saw now on the market. A small, circular saw, mounted at the end of a hollow aluminum pole, is whirled by means of a flexible drive shaft connected to a small gasoline engine. Without climbing, a worker can trim off dead or useless branches as high as twelve feet above the ground. The sixty-pound unit is pulled from tree to tree on a small toboggan sledge. It is equally suited for pruning trees on city streets, large estates, in parks, and orchards.

OUTFIT FOR PHOTO ENLARGING FITS INTO CARRYING CASE

COMPLETE in all its details, a photograph-enlarging outfit has recently made its appearance compactly arranged and mounted in a suit-case container. When opened for use, as shown in the illustration, the lid of the case holds an all-metal easel equipped with margin control, paper holder with etched scales, and a focusing magnifier. Extended on its mounting above this working surface is the enlarging camera, controlled by a geared micrometer-focusing mechanism which enables the user to obtain sharp definition accurately and quickly. In addition, the equipment includes a built-in darkroom lamp and an electric timer.

Portable photograph-enlarging outfit set up for use. The lid of the case is equipped to serve as the easel

DUAL RADIO RECEIVER ENDS NOISE

James J. Lamb, radio engineer, at work on his new radio receiver

FADING, station interference, and noise are minimized in a new radio receiver developed by James J. Lamb, prominent radio engineer. Two synchronized receiving sets, each having its own antenna, pick up and amplify the same signal. A single control knob tunes both sets simultaneously. Just before the signals enter the last stage of the twin circuit, they are combined by a special mixing circuit in such a way that the stronger signal "kills" or blocks out the weaker before reaching the loudspeaker, thus preventing the weak or undesirable signals from spoiling the reception of the program.

EQUIPS LABORATORY FROM P.S.M. PLANS

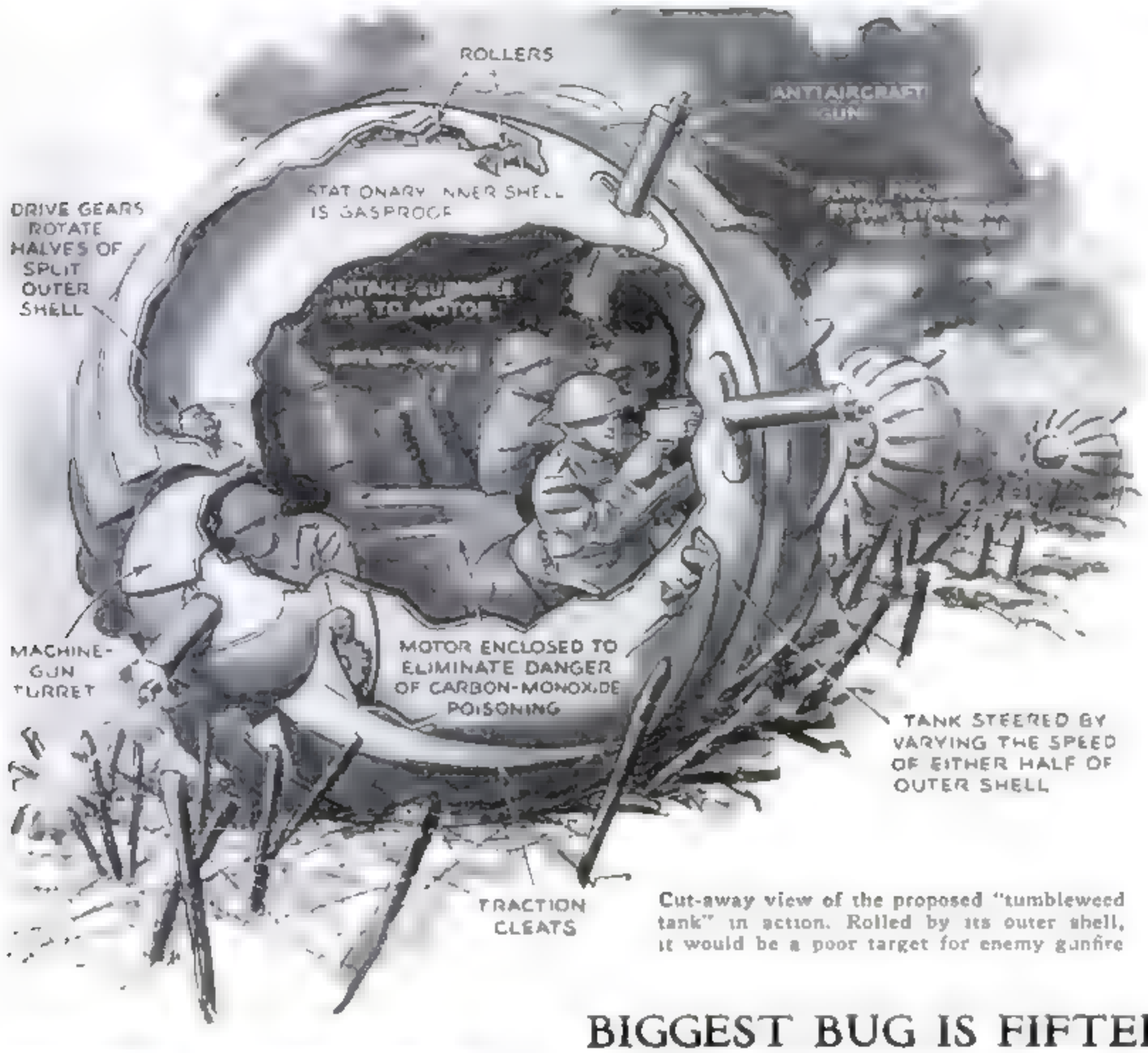
This complete home laboratory even boasts black-light equipment

FOLLOWING plans published in POPULAR SCIENCE MONTHLY, Allan G. Butler of Belleville, N. J., constructed most of the equipment for the home chemistry laboratory shown in the photograph. The apparatus includes a microprojector, black-light apparatus, arc lamps, microscope accessories, test-tube racks, retorts, and other utensils. The workshop library consists of 200 scientific books, bound volumes of POPULAR SCIENCE MONTHLY, scrap books, and filing cases for miscellaneous material. The lab is equipped for the study of biology as well as chemistry.

CIGARETTE HAS FILTER IN TIP

A NEW cigarette has a novel filter tip made of rolled, pleated paper. Besides protecting the smoker's lips from the annoyance of loose tobacco ends, the rolled-in filter is said to provide a cooler smoke.

Novel War Tank Resembles a Rolling Ball



Cut-away view of the proposed "tumbleweed tank" in action. Rolled by its outer shell, it would be a poor target for enemy gunfire

ROLLING over the ground like a giant ball, a high-speed "tumbleweed tank" proposed by a Texas inventor is a new addition to modern war machines. A spherical hollow steel driving cab is inclosed by a rotating outer shell consisting of two cup-shaped halves fitted with circular traction cleats. Motor-driven gears, mounted on the inner sphere, rotate the outer shells to roll the tank along the ground. Steering is effected by varying the speed of either of the rotating traction shells. Machine guns are fired from the stationary cab through central firing slots and armored turrets at the sides. The heavy driving motor, centrally placed on the cab floor, gives the tank stability and prevents it from rolling sidewise. The inner shell can be sealed against poison gas, while the power plant is completely inclosed to minimize the danger from exhaust fumes. The inventor states that the tank's spherical shape presents the smallest possible target for enemy bombs or shells, and all but direct hits would glance off its curved sides. Missiles penetrating the outer shells would have expended most of their force.

BIGGEST BUG IS FIFTEEN INCHES LONG

A GIANT "walking stick" recently obtained by the general science department of New York University, in New York City, is believed to be the largest insect in the world. The huge specimen measures fifteen inches from the end of its hind legs to the tips of its wirelike feelers. It was found by a collector on the island of New Guinea in the East Indies. In the photograph at the right, a student is holding a foot rule alongside the huge specimen to show its comparative size.

A specimen of the "walking stick," huge East Indian insect, acquired for study by New York University

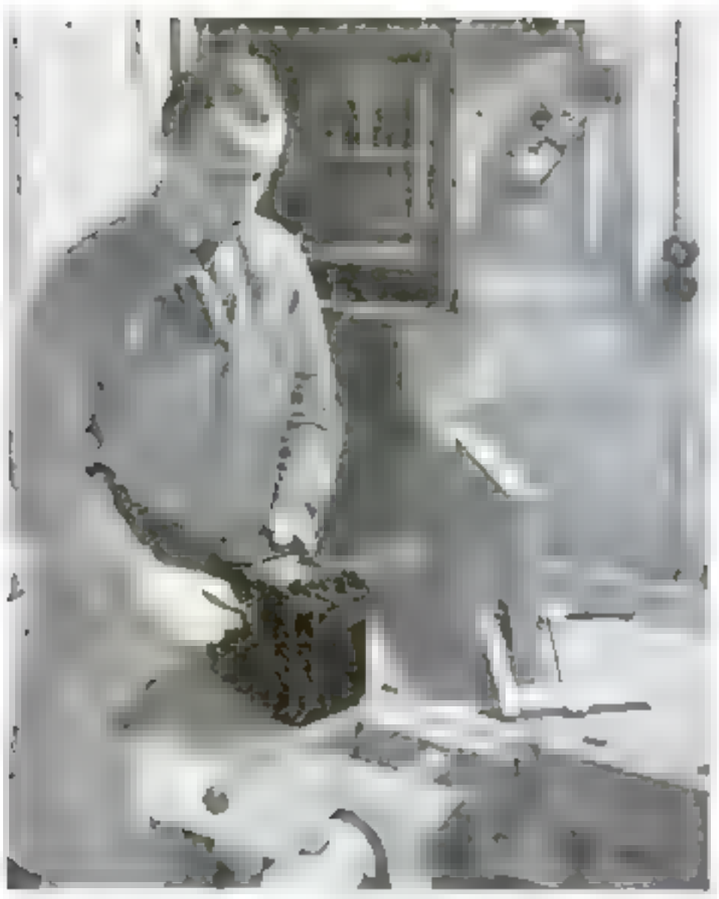
HOT WATER WARMS DIVER

DESIGNED for work in cold temperatures, a new French diving suit is warmed by hot water supplied from the surface through flexible tubes. Made of a rubberized fabric, the suit, when donned by the diver, is sealed by a water-tight slide fastener. The heated water, circulating between the outside layer and a waterproof lining, is said to enable a diver to work comfortably despite frigid outside temperatures. By means of a valve, the diver can control the circulation of hot water.

Below is a scale model of a 100,000-ton liner with upper deck cleared to let airplanes land

AIRPLANE DECK FOR LINER

FUNNELS disappear amidships and hinged masts swing downward to clear a spacious airplane-landing deck on a proposed 100,000-ton superliner. The huge ship would be 1,250 feet long, with a cruising speed of thirty-four knots and a passenger capacity of 10,000. In war time the liner could transport 20,000 troops and carry its own convoy of airplanes.



NOVEL METER GAUGES MOISTURE IN WOOD

TO DETECT excess moisture in raw lumber, which may cause later shrinkage in the finished wood, a German inventor has developed a novel "moisture meter." The apparatus is based on the fact that the electric resistance of wood depends on the amount of water it contains. A sample of lumber is placed between two electrodes in an electric circuit. A meter indicates the electric resistance of the wood and a calibrated scale shows the percentage of moisture present.

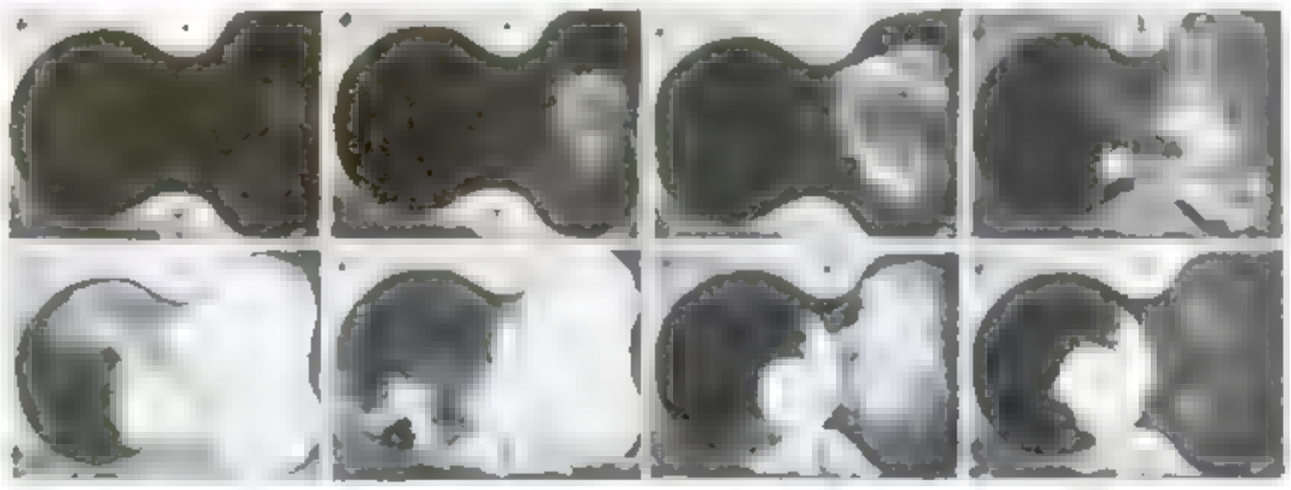
SUN ROASTS MEAT IN BEACH BARBECUE

HEAT from the sun, concentrated by a bank of twenty mirrors, roasts meat to a delicious brown in a beach barbecue machine invented by a Los Angeles, Calif., man. The motor-driven spits are inclosed in a glass case which is mounted with the mirrors on a revolving turntable. As the direction of the sunlight changes, a thermostat automatically causes the turntable to revolve, keeping the reflected rays constantly focused on the meat. A simple adjustment makes allowance for seasonal variation in the altitude of the sun.

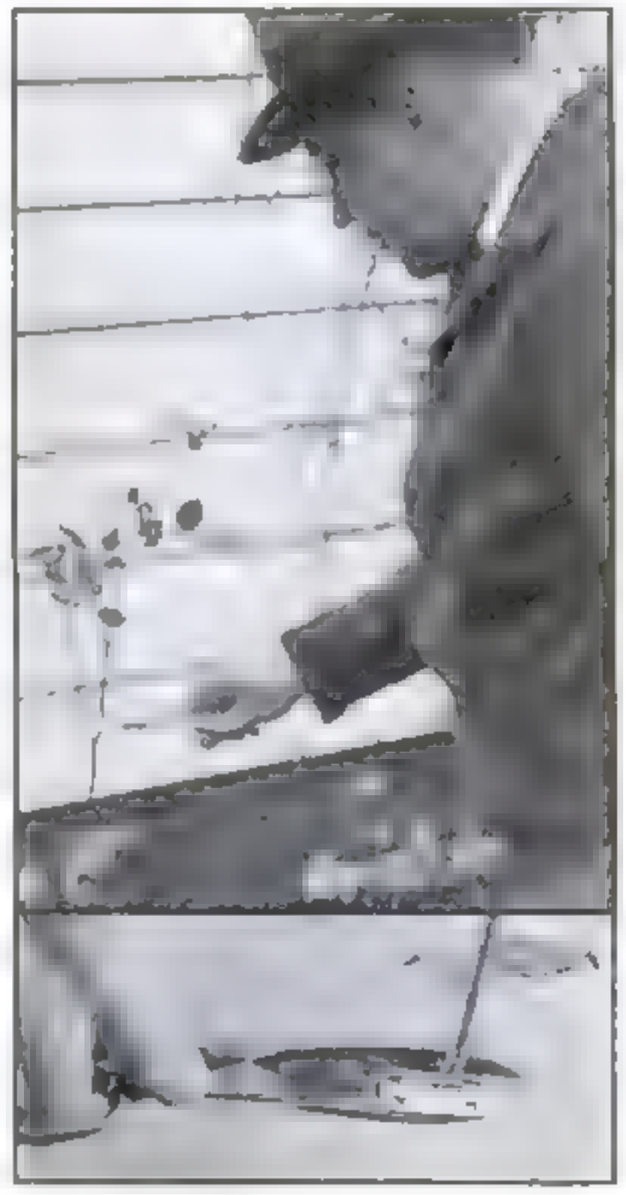
H. E. McCoy (in cook's regalia) demonstrating his solar barbecue to bathers at a California beach

MOVIES SHOW AUTO-CYLINDER EXPLOSIONS

TAKING pictures at the amazing rate of 5,000 a second, a new high-speed movie camera records the details of fuel explosions inside a gasoline engine in operation. Light from the spreading flame in the combustion chamber passes through a transparent quartz window, which covers the entire top of the engine, and is reflected into a stationary lens. Thirty small lenses, mounted on a rotating steel disk, whirl by the stationary lens; each exposing a single image of the explosion chamber on a strip of film moving at a speed of over 200 miles an hour. When the film is projected on a screen, the pictures can be studied frame by frame, or as a continuous, ultraslow-motion reënactment of the cylinder explosions. When an automobile engine is running at 2,000 revolutions a minute, equivalent to a road speed of about forty miles an hour, 250 explosions occur in a second; the high-speed camera would record each explosion in twenty individual snapshots. The film, instead of moving in jerks between pictures as in ordinary motion picture cameras, moves continuously over a large disk attached to the crankshaft of the engine. The camera is expected to be of great value in research studies of gasoline combustion.



This ultrafast camera photographs the spreading of the flame in the combustion chamber of an automobile engine. The circular drum contains the film and the rotating lenses. At the right are flame pictures made at the rate of 5,000 a second



SHEARS GRIP FLOWER AFTER CUTTING STEM

WITH shears of a new type, a home gardener can reach into a flower bed and, with one hand, cut and gather a desired bloom. On one of the jaws of the shears is mounted a spring-operated clamp that has a corrugated edge facing the tool's cutting surface. As the flower stem is cut, the clamp automatically grips it.

The Man with the Net

FINLAND *has the only paved highway in the world to the shore of the Arctic Ocean.*

ICE *that remains ice even when heated above the boiling point of water has been produced under a pressure of 360,000 pounds.*

HORSE STEALING *draws a heavier penalty than the theft of an automobile in eighteen states and the District of Columbia.*

MAN *has grown two inches in average height within the past century.*

SIX BILLION CANS *of foodstuffs were packed in this country during 1935.*

A BIRD'S BLOOD *has more red corpuscles to the cubic centimeter than that of any other animal.*

SAUERKRAUT *is being used by museums to clean priceless tapestries and rugs.*

COLORADO'S LOWEST POINT *is more than a half mile high.*

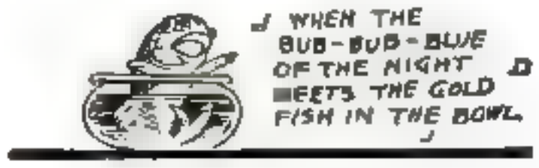
A BEETLE, *found in Java, secretes a narcotic. It allows ants to feed upon the secretion, then devours them when they are helpless.*

A TANK CAR *loaded with helium gas shipped by the Navy weighed 92,000 pounds less than the empty car.*

THE MALE SEA HORSE *performs the role of mother. It is the male that gives birth to the young.*

THE CAESAREAN OPERATION *was not named after Julius Caesar, as generally believed. Instead, his family probably got their cognomen from the operation.*

GOLDFISH *show a color preference for blue.*



AUTOGIRO FLIES FROM STAGE IN PLAY

A REAL airplane thrilled audiences at a recently opened musical production in London, England. The novel "property" was an autogiro of latest design, equipped as for a regular flight. Through skillful stagecraft, it took off and disappeared behind the scenes, apparently under its own power, with motor roaring and "windmill" blades spinning. The photograph shows the take-off scene in the play.

VACUUM BRUSH DUSTS BOOKS ON SHELVES

WITH a vacuum-cleaner attachment, recently invented by former Secretary of War Newton D. Baker, books can be dusted without removing them from their shelves. The device consists of a rectangular brush connected to an electric hand-type cleaner by a hollow wooden neck or handle. When the accessory is brushed along the tops of books, without taking them from their places on the shelves, the bristles loosen accumulated soot and dirt, which is then sucked through the tube to the dust bag.

Novel vacuum-cleaner attachment in use for dusting books

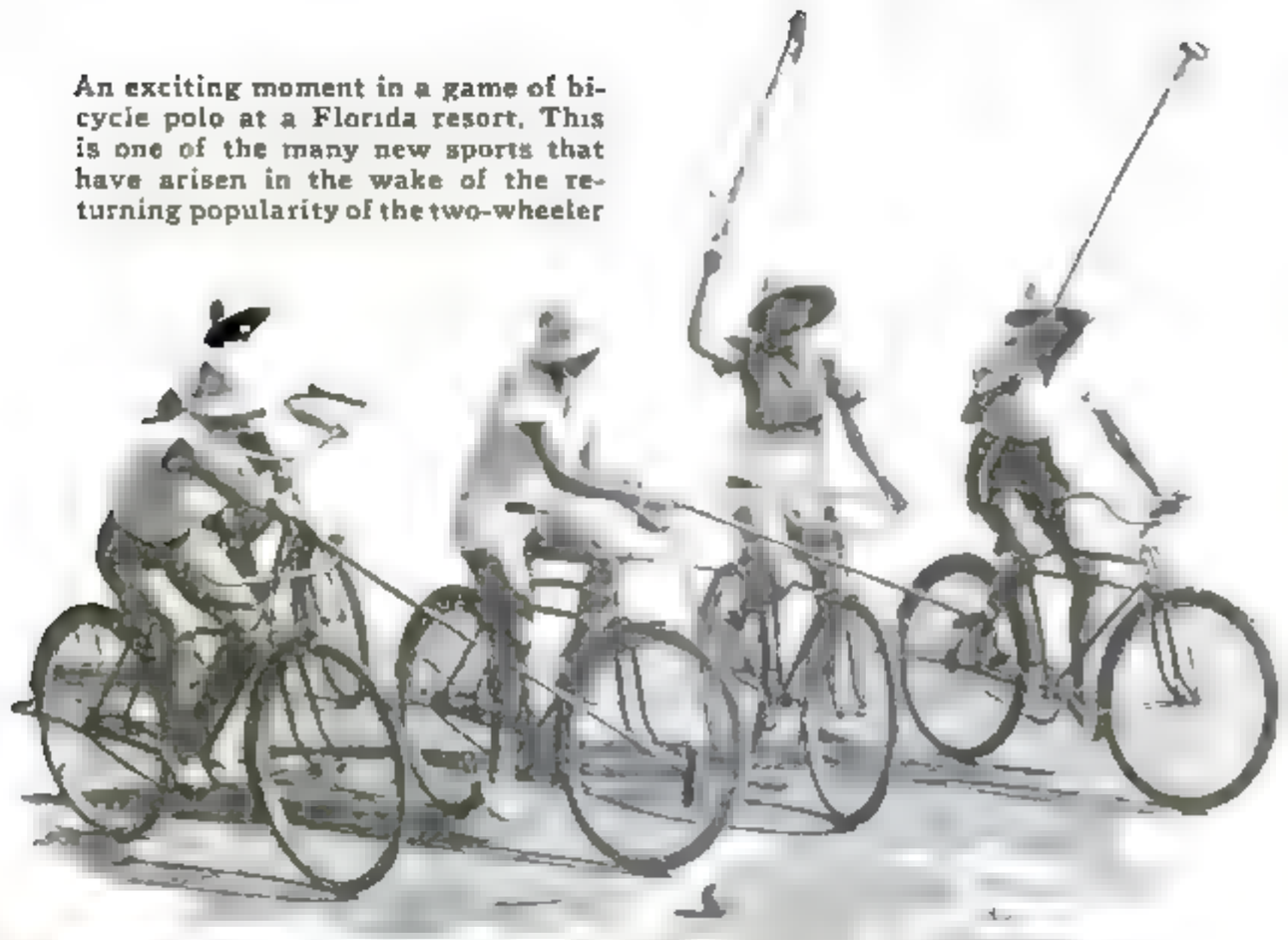
ARCTIC CABINS HAVE WINDOWS HEWN FROM ICE

LOG SHELTERS constructed in northern Russia for Soviet fishermen have windows of ice instead of glass. Thick slabs, cut from clear ice, were hewn to shape, fitted into the window frames, and frozen in place. Constant sub-zero temperatures keep the ice windows frozen solid throughout the long winter months. Seen from the outside, the ice windows sparkle with the electric lights in the cabin's interior.

Ice blocks form the windows of this Soviet fisherman's arctic hut

The BICYCLE

By JOHN E. LODGE



An exciting moment in a game of bicycle polo at a Florida resort. This is one of the many new sports that have arisen in the wake of the returning popularity of the two-wheeler

THE bicycle is back. Four million Americans now pedal along streets and highways. And, last year, factories in the United States turned out 750,000 machines, nearly equaling the peak production of the gay nineties. News items from all parts of the country tell the story of this dramatic boom in popularity.

In Chicago, Ill., for instance, 165,000 persons recently signed a petition asking for cycling paths to be constructed in the city parks. In Washington, D. C., a huge crowd of enthusiastic spectators, last winter, braved frigid winds for hours to watch an amateur bike race. From coast to coast, cycling clubs are springing up. The veteran League of American Wheelmen has come back to life. The Amateur Bicycle League of America has approximately ninety affiliated clubs; the Century Road Club, promoting amateur races, has twenty-five or thirty, and there are upwards of 300 unassociated clubs in the country.

In 1933, a survey conducted by department stores showed that bicycles stood fourth on the list of things that boys and girls wanted for Christmas. In 1935, they stood first. Almost every large city has bicycle rental stations, and several have schools for teaching the fine points of cycling. Railroads are running special "bicycle trains" that carry enthusiasts and their wheels to scenic spots for one-day outings. The bicycles ride in special baggage cars, where passengers may also rent machines if they so desire.

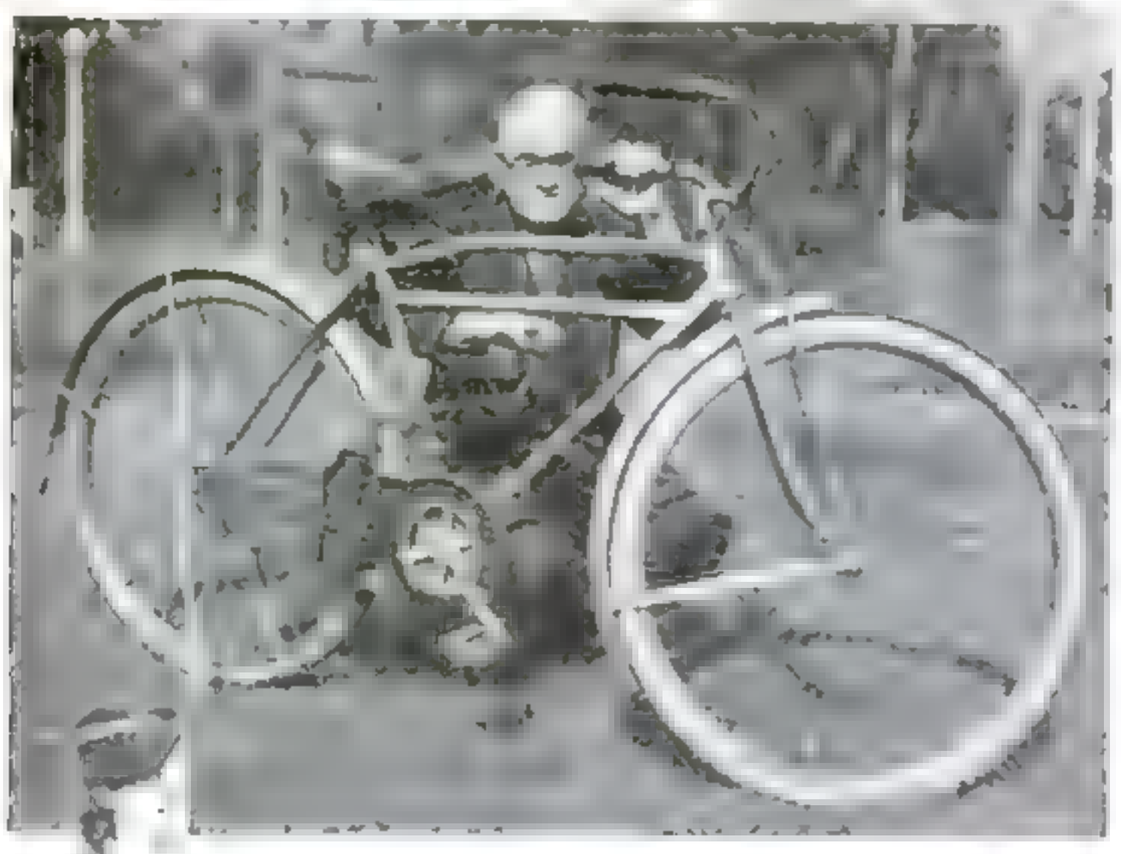
Last summer, when the Boston and Maine Railroad inaugurated the idea, its first Sunday excursion to the wooded section of New Hampshire carried 200 cycling enthusiasts, in spite of the fact that the day was rainy!

This season, the bicycle-train idea is spreading. From New York, excursions will run to the Highlands of the Hudson and to Connecticut; from St. Louis, Mo., others will carry bicycle fans of that city to outlying, picturesque spots. Railways in other parts of the country are also adopting the idea.

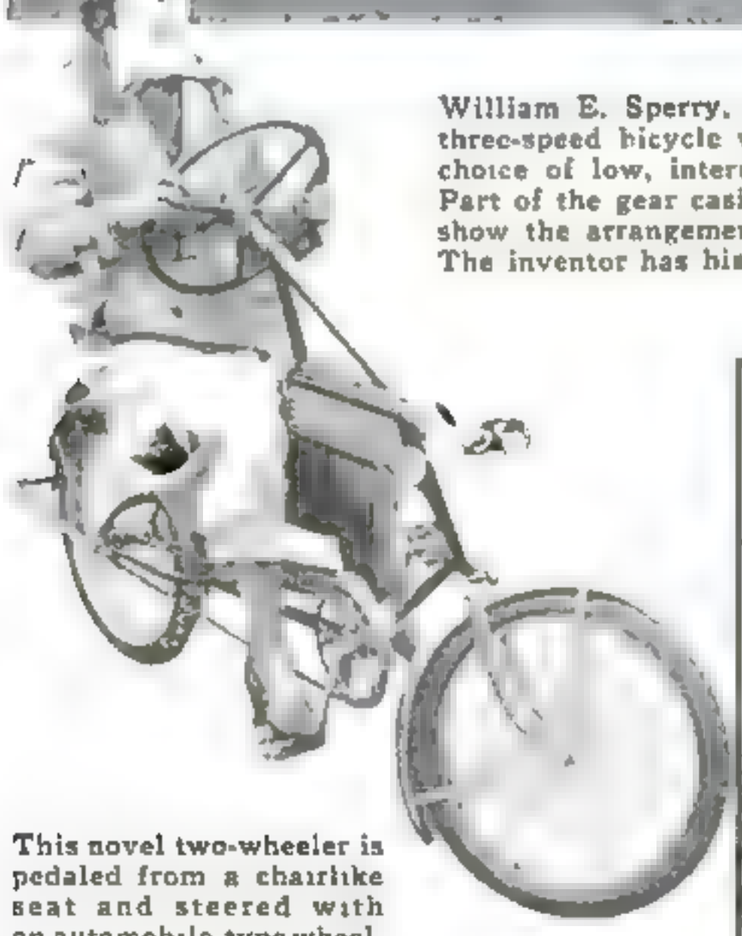
A "bicycle breakfast" was staged not long ago by a charity organization in New York City. One morning, a horde of riders gathered in Central Park and pedaled in parade formation downtown to a popular restaurant. Staid old Fifth Avenue had not seen so many wheels in one group since the days when they shared the streets with the horse car.

Instead of subsiding, the tide of cycling popularity continues to rise. What is the secret of the bicycle's amazing comeback?

Running over its history, we find that it wasn't until about 1885 that the modern bicycle came into existence. Five years later, the "bicycle craze" was sweeping the country. By 1898,



William E. Sperry, inventor, displaying his three-speed bicycle which gives the rider a choice of low, intermediate, and high gear. Part of the gear casing has been removed to show the arrangement of the working parts. The inventor has his hand on the shift lever



This novel two-wheeler is pedaled from a chairlike seat and steered with an automobile-type wheel. Note twin headlamps

At the right, 300 girl cyclists are waiting for the gun to start them off on a recent ten-mile race in California. Hundreds of amateur races are scheduled for this summer

Comes Back

IN AMAZING REVIVAL OF FAD OF THE NINETIES

American manufacturers were producing approximately 1,000,000 machines a year. Factories were humming; every village had its thriving bicycle shop.

Then interest waned. A blight seemed to attack the industry. By 1904, production had dropped to 200,000 machines, and thousands of bikes were reposing with flat tires and rusty spokes in cellars and attics, woodsheds and barns. The bicycle's day seemed to be over.

Manufacturing statistics show that production in 1909 was 168,000; it was 299,000 in 1914; 216,000 in 1921; 255,000 in 1927; and 260,000 in 1931. Then, during the worst depression the country has known, the old-fashioned bicycle took a new lease of life. Something began to happen to the "forgotten vehicle." Workmen trickled back into bicycle factories. Dealers reported increased demand. Production totals jumped, until in 1935 they were almost three times what they had been in 1931.

What had happened?

Various explanations have been advanced. About 1932, it is pointed out, publicity agents for Hollywood movie stars began to run out of ideas for "different" pictures that would be printed in newspapers and magazines. The actors and actresses had been shown engaging in every form of athletics, wearing almost every known costume, and riding in almost every kind of motor vehicle. The publicity men hit on the idea of having their stars photographed riding bicycles. Almost overnight, Hollywood became "bicycle conscious." What started as a mere publicity stunt, turned into an authentic cycling craze.

One prominent actor pedals ten miles between his home and the studio twice a day, rain or shine. Some Hollywood stars adopted the bike as a pleasant form of exercise, others as an easy way to pedal off a few excess pounds. But most of them continued to ride because they had discovered that cycling was fun.

The bicycle craze spread up the California coast to San Francisco. Society leaders took up cycling as a novelty, and ended by adopting it as a regular activity. The popularity of cycling spread inland. Before it could reach the Atlantic coast, Boston, New York, and Washington had already been bitten by the bicycle bug from another direction.

During the depression, many people who formerly had traveled abroad, saved money by a trip to near-by Bermuda. Here, automobiles are taboo and bicycles abound. The American tourists caught the cycling craze, brought it home, and spread it throughout the East.

During A Century of Progress Exposition, in 1934, a "bicycle day" brought 25,000 persons pedaling through the gates into the grounds on the Chicago lake front. Today, hardly a city or state is untouched by the bicycling wave which has swept the country.

New designs, mechanical refinements, ingenious accessories are a feature of present-day machines. Bicycles of radically new design are making their appearance. There are bikes with three-speed gear shifts, automobile-type *(Continued on page 10*

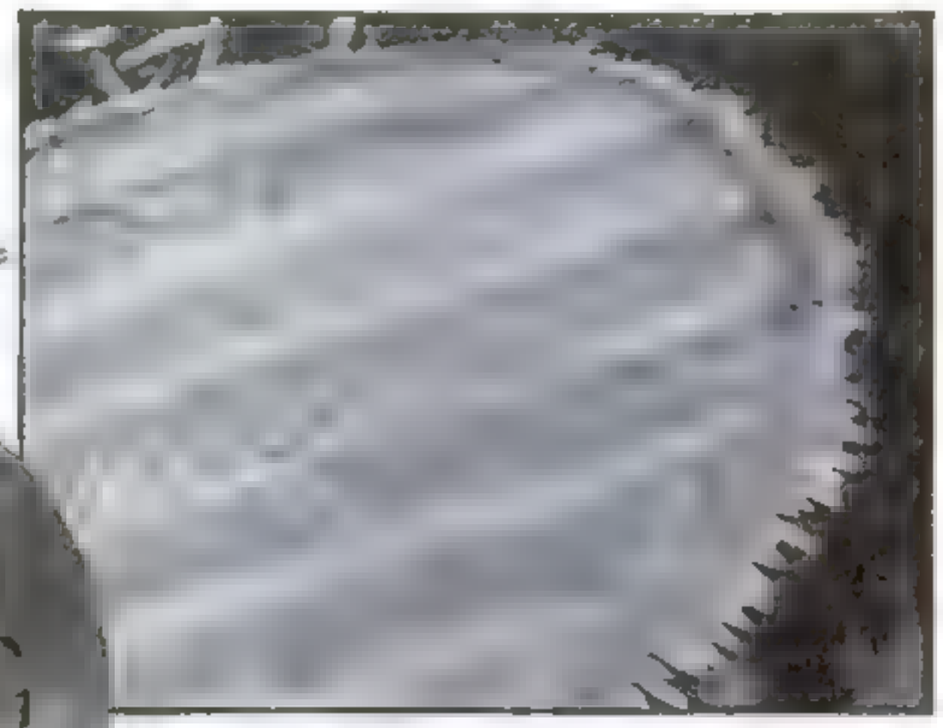
How Grandfather would have stared at this ultramodern, streamline machine! It has a speedometer (seen in circle), horn, and headlight with a battery in the frame

The 1936 version of "a bicycle built for two." So insistent has been the demand for tandem wheels that manufacturers have begun manufacturing them again for general use

A bicycle train discharging its load of city cyclists for a day awheel in the country. The passengers' machines are carried in the baggage car, and extra ones are available for rent

Exploring the WITH YOUR

A dissecting microscope being used in removing the outer layer of a honeybee's eye



A HOLDER FOR TURNING INSECT SPECIMENS

The simple device pictured above enables you to rotate subjects as you examine them. In the upper photomicrograph at the right is a wing tip of a mosquito, and below it is the insect's head. The black areas at right are compound eyes

By

Morton C. Walling

TURN the magic eye of your microscope into every corner of the world about you, and you will find no more entertaining objects than the insects. There is scarcely an insect foot, eye, or wing that, under the revealing power of lenses, does not become a thing of surprising beauty to the person seeing it for the first time, and an object surrounded by still unsolved mysteries to the microscopist who has seen it a thousand times before.

Insect bodies and wings often are clothed with scales and hairs, and various structures ranging in form between these two, of great beauty of form, color, and texture.

Capture a butterfly and rub one of its wings against a clean glass slide. If you fail to obtain in this way a collection of tiny scales, breathe on the slide to moisten it, and rub again. Also, clip a section from the wing and lay it on a slide, being careful not to rub off too many scales.

An insect scale, you will find, frequently resembles a plant leaf or, in many cases, a flat paddle with a handle that tapers more or less to a point. Most scales are marked with ridges and grooves that run either parallel to the stem or "handle," at right angles to it, or in a radiating pattern. These markings are very fine, especially in some scales.

The appearance of a small section of such wings as those of butterflies and moths, and parts of the bodies of some insects, when magnified fifty or so diameters, is somewhat like that of a shingle roof. The scales are arranged in overlapping rows, and each scale is attached to the wing by its tiny stem. You will find that the coloring, seen in such objects lies entirely in the scales, and that the part of the insect to which they are attached, as the wing of a butterfly, generally is colorless. Scales of various colors and hues are found on the same insect or the same wing. Some scales, as those of certain beetles, have a beautiful, metallic sheen that is best seen by reflected light.

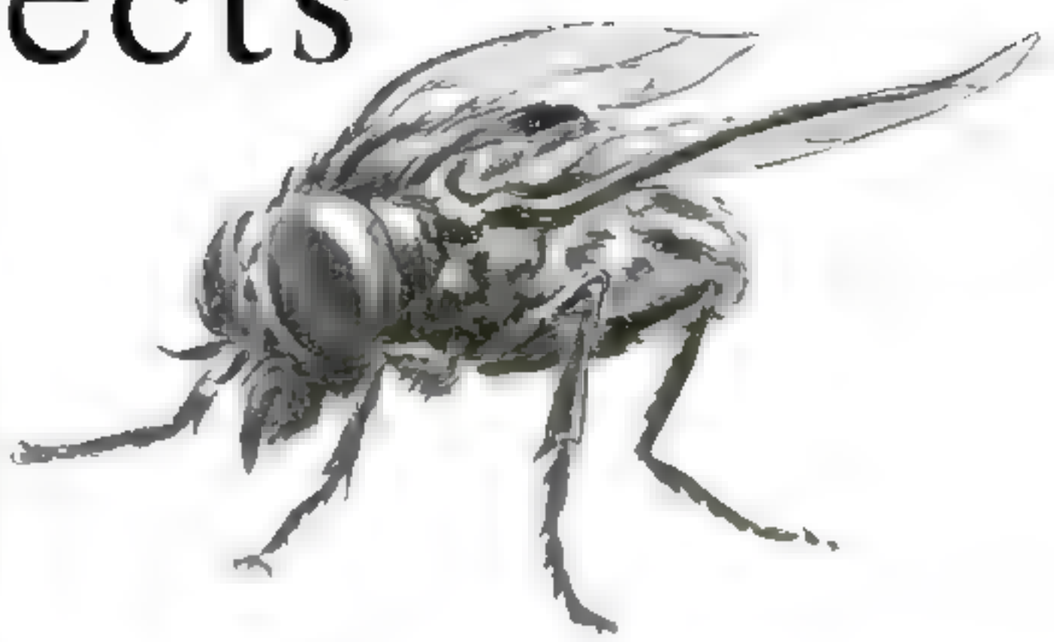
Scales seem to be, in structure, essentially dried cells whose walls have collapsed to form thin, more or less flat objects, something like a folded paper bag.

Insect hairs present a wide variety of sizes and shapes. Some are flat and sharp-edged, like the blade of a bayonet. Some are long, tapering, and pointed, like a keen lance. Others are equipped with knobs, often highly ornamental, along their shafts and at their tips, like war clubs. Still others have peculiar tips which resemble arrows or spearheads. On some in-

LOOKINGTHROUGHTHE EYE OF A HONEYBEE

This is an actual photograph of the multiple images formed by the compound eye of a bee. The object viewed is a small microscope framed in a window. The drawing shows the set-up for making the picture

World of Insects MICROSCOPE



sects, such as the diamond beetle, you can find various appendages ranging in form from hairs to scales, with many different shapes between these extremes.

Some hairs and scales look best when placed on the slide dry, and viewed by either transmitted or reflected light. Others should be mounted permanently in Canada balsam. To determine which method of mounting is best, without making slides of each kind, drop a little turpentine on some of the hairs or scales to be mounted. If this makes them more brilliant and clear, the balsam mount will be better. Otherwise, mount them dry in a cell formed by spinning a ring of shellac on the glass slide, or by cementing, with balsam, a thin washer of cardboard in the center of the slide. The specimens can either be placed loosely in the shallow depression thus formed, and sealed in by a clean cover glass; or a very thin layer of some adhesive such as balsam thinned with xylol can be spread over the cell bottom to hold them in place.

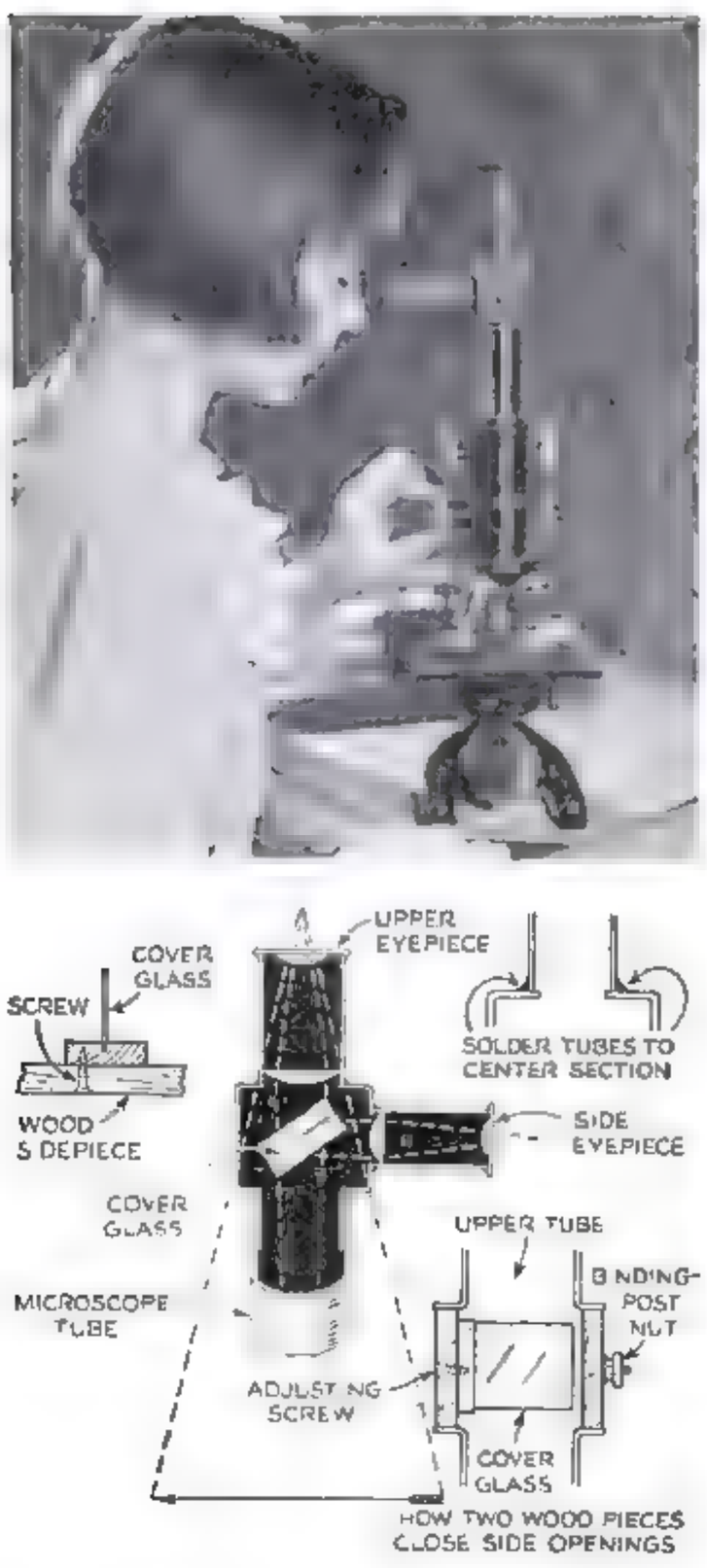
The antennas of many insects, particularly of certain moths, are objects of distinction and beauty. They range in form all the way from simple, hair-studded rods to elaborate plumes that might make an ostrich envious. So much do antennas vary—frequently even between males and females of the same species—that they are used by entomologists as a tag for identifying many of the various types of insects.

THE antennas of large insects generally are seen satisfactorily by laying them on a slide and examining them in air. For permanent mounting, balsam may be used. The specimens should, of course, contain no moisture. Simply drying them in air for a few days usually will suffice. For very small insects, it is best to mount the entire head. Some microscopists recommend that these delicate specimens be mounted in some fluid such as glycerin, rather than in balsam.

The remarkable mechanical ingenuity displayed by nature in the insect world can be seen nowhere better than in the wings of the various flies, beetles, locusts, and other flying insects.

Insect wings are structures of very great strength and extremely light weight. Examine a wing of a honeybee and a wing of a mosquito with your microscope. You will find that both are covered with stiff, tapering hairs or spines, some long and others short. The mosquito has, in addition, ridged scales arranged in rows along the wings and forming fringes around the edges, like exquisite embroidery work. Focus very carefully on the hairs of the bee's wing, *(Continued on page 102)*

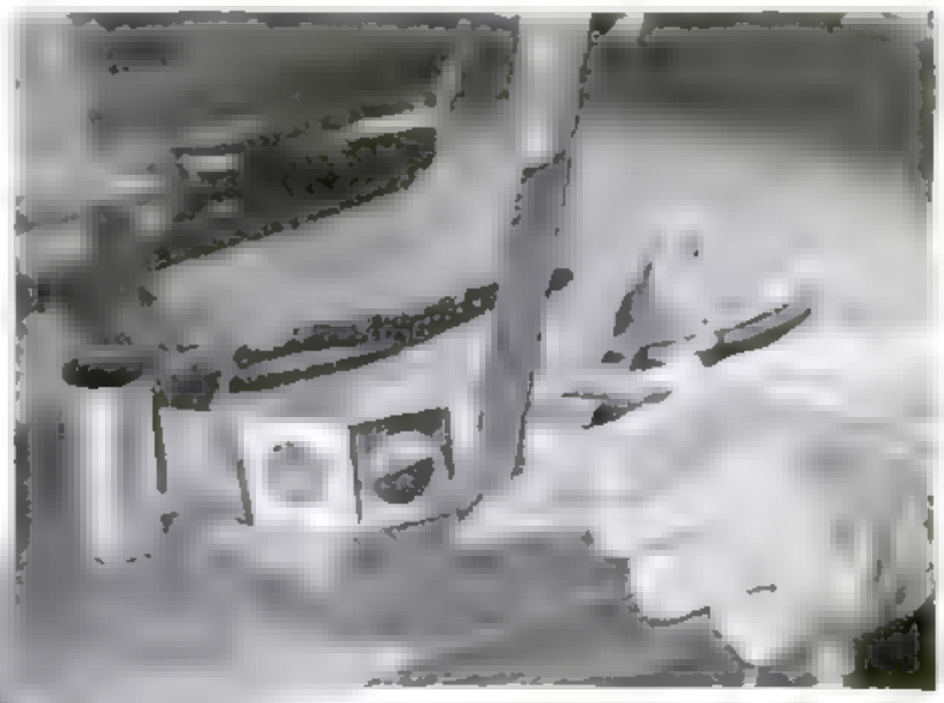
DOUBLE EYEPIECE LETS TWO PERSONS LOOK AT ONCE

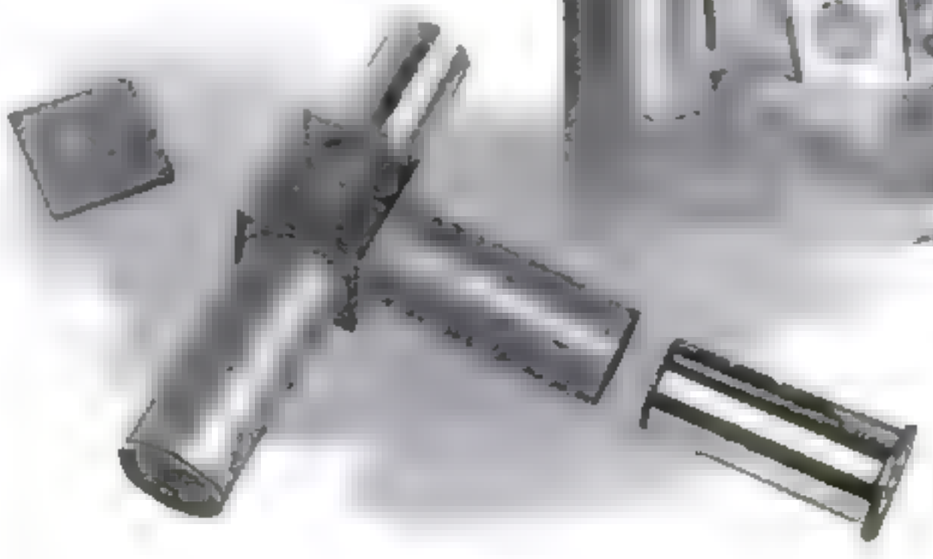


DID you ever want to look at an interesting object through your microscope and at the same time show it to a friend? You can do it if you have a demonstration attachment. This is simply a device, easy to make, which splits the microscope light beam into two parts, and sends each through a separate eyepiece.

You will need, in addition to an extra eyepiece, preferably of the same power as the one you have, a very thin (No. 1) cover glass and some tubes of cardboard or metal to receive the eyepieces and to fasten the attachment to the microscope. Construction is shown clearly by the illustrations. Paint all inside surfaces a dead black, using thin shellac to which drop black (Frankfort black) has been added, or special paint you can get from photographic dealers

When using the demonstration attachment, one observer looks into the top eyepiece and the other into the side eyepiece. When first using the device, the two eyepieces must be adjusted so that they are the same distance from the objective, measured along the path of the light rays. This is done by focusing through the top eyepiece, and then, without moving the microscope focusing knob, sliding the side ocular back and forth until the image is sharp. Some loss of definition will be noticeable through the side eyepiece because of light being reflected from both surfaces of the cover glass; but usually this is not excessive if the glass is thin.





Assembly of three metal tubes and center section for demonstration eyepiece. At left is the complete attachment, with eyepieces, cover glass as beam-splitting mirror in the center, and the composition sidepiece

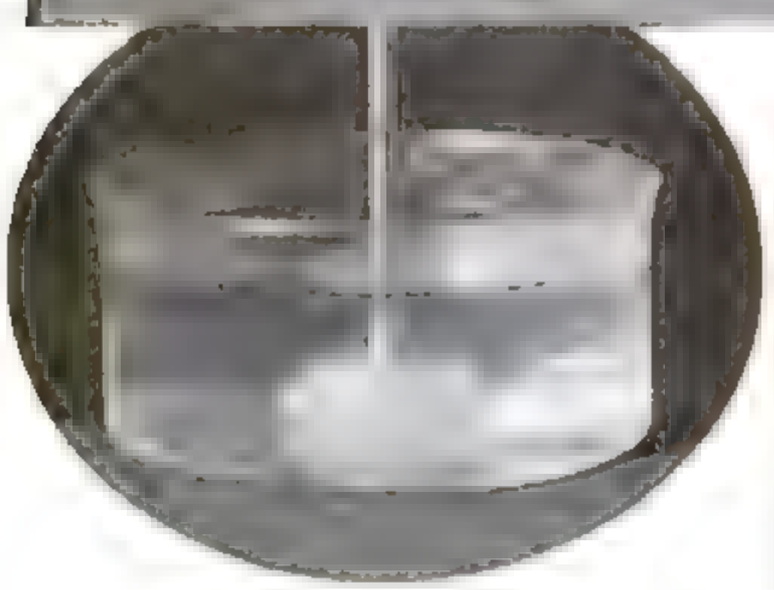
SIMPLE EXPERIMENT SHOWS

How the Universe Was Formed

By Gaylord Johnson

•

At the right is a photograph of a giant spiral nebula, taken with a great telescope which picked up rays of light that had traveled through space for hundreds of thousands of years before they reached the earth. The two curving arms, reaching out from opposite sides of the central mass, are typical of all spiral nebulae. The easy test described on this page shows why there are always two arms



In the upper picture, a dropperful of machine oil is being squeezed into a beaker of wood alcohol to form a globule as illustrated in oval

A TINY globule of machine oil, spinning around in a beaker of wood alcohol, will reënact for you one of the most stupendous dramas of the universe—the formation of a giant spiral nebula.

Photographs of these far-off galaxies of stars made through giant telescopes show that, in spite of minor physical differences, they all have one feature in common: the main structure consists of two curving arms spiraling out from opposite sides of a central mass.

Obviously, this structure is the result of a whirling, centrifugal force. But why should there always be just two arms? That is what this simple demonstration will show you.

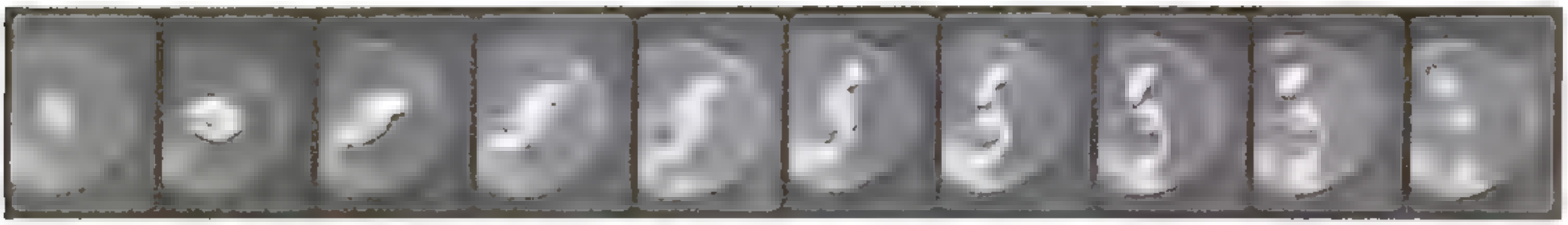
Squeezed from a medicine dropper under the surface of wood alcohol placed in a glass beaker, a dropperful of ordinary machine oil forms a thick disk about half an inch in diameter, and represents, for purposes of illustration, the physical properties of a rounded mass of nebular gas suspended in space.

To complete the analogy, it is necessary to impart a whirling motion to the globule. This is done by means of an ordinary hand drill mounted vertically on a laboratory stand as shown in the illustration. The drill chuck holds a piece of brass tubing, to the lower end of which a metal-headed thumb tack has been fastened by soldering its point into the opening in the tube. Soap the tack head to make it grip the oil more effectively.

When you are ready to begin the experiment, lower the support holding the drill until the thumb tack comes in contact with the disk of oil and presses it gently against the bottom of the beaker. Now you will find that by turning the drill crank you can cause the globule to whirl around. The strip of pictures reproduced at the bottom of this page shows what happens.

As the motion starts, the oil will assume an oval shape, the two elongated ends representing the beginnings of the spiral arms. With increasing speed, these two ends will spread out into the curving shape that is typical of the arms of spiral nebulae. Finally, as a still higher speed is reached, portions of the arms will break off and assume spherical forms, resembling the mass at the end of one of the spirals in the typical nebula photograph reproduced on this page. No matter how many times you try it, only two arms will be formed.

You have created a tiny representation of a giant nebula in the beaker by applying the same force that forms the vast galaxies in the farthest depths of space—the force that astronomers believe shaped the universe itself. Crude as this demonstration is, it serves to show the same truth that astronomers verify with the most elaborate instruments—that the whole universe, from the infinitesimal to the infinite, is governed by the same immutable laws.



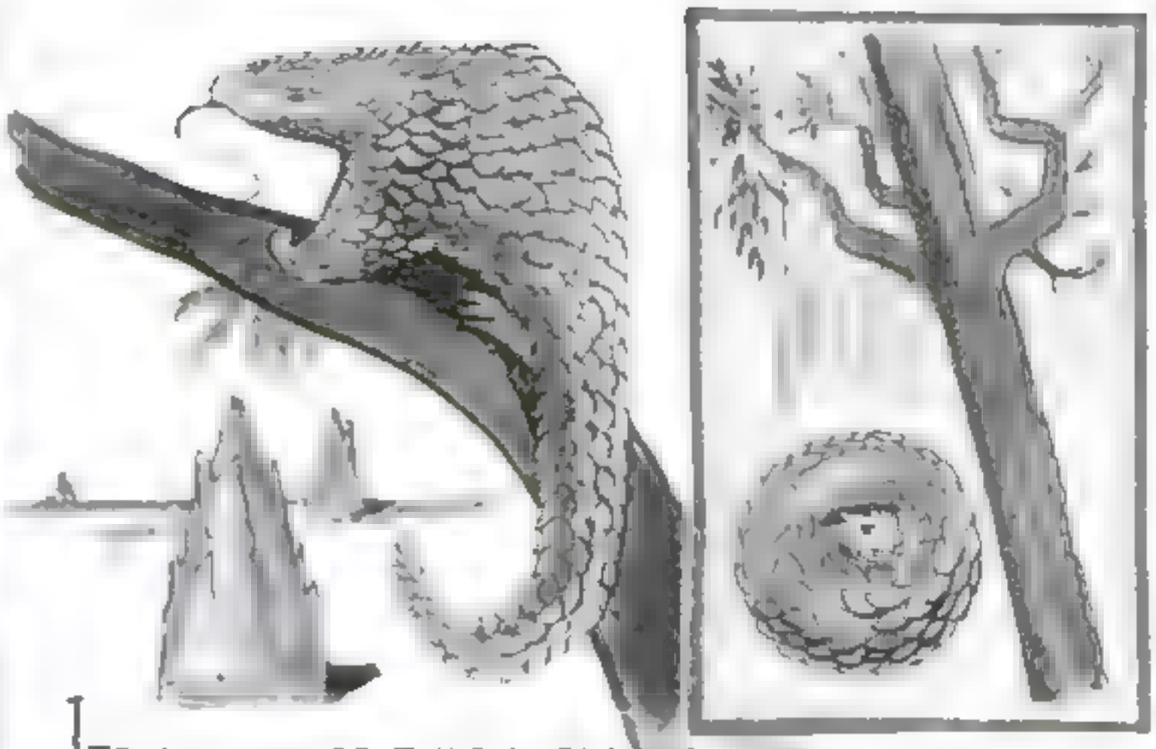
Rotated by means of a thumb tack soldered on the end of a shaft that is gripped in the chuck of a hand drill, the oil assumes an elongated shape

As the speed is increased, two curved arms go out from the central body and break off, to form round masses like those seen near spiral nebulae

Un-Natural History

By GUS MAGER

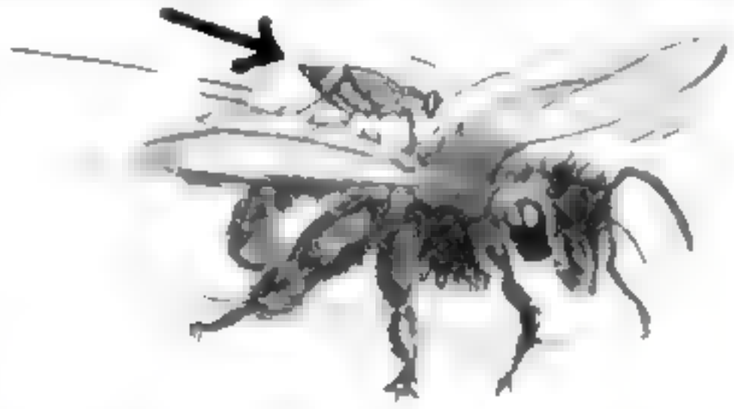
ALTHOUGH IT HAS FIFTY-ODD TEETH — MORE THAN ANY OTHER LAND MAMMAL — THE **MYRMECOBIUS FASCIATUS**, OF AUSTRALIA, LIVES ALMOST EXCLUSIVELY ON ANTS! WHAT CAN BE THE IDEA OF ALL THAT BRIDGEWORK?



ITS ARMOR OF THICK PLATES MAKES THE **PANGOLIN**, OR SCALY ANTEATER (AFRICA AND ASIA), LOOK MORE LIKE A PREHISTORIC REPTILE THAN A MAMMAL IN GOOD STANDING. WHEN IT WANTS TO COME OUT OF A TREE IN A HURRY, IT ROLLS ITSELF UP IN A BALL AND LETS GO!

ISN'T IT STRANGE THAT NATURE'S HEFTIEST FRUIT, THE **PUMPKIN**, GROWS ON A WEAK, GROUND-CLINGING VINE! AND NOBODY KNOWS WHERE IT CAME FROM. SOME SAY IT IS A NATIVE AMERICAN LIKE THE POTATO, OTHERS THAT IT CAME FROM THE FAR EAST WITH THE CANTALOUPE AND CUCUMBER!

SOLE DESCENDANT OF THE LONG-EXTINCT ANIMAL GROUP OF TRILOBITES THE **HORSESHOE CRAB** IS THE ONLY LIVING CREATURE THAT HAS ITS TEETH ON ITS LEGS. THEY ARE SHARP SPINES WHICH ACT AS TEETH, TO TEAR THE FOOD BEFORE IT IS SWALLOWED!



THE ORIGINAL AIR-LINE STOWAWAY IS THE **MELOE**, OR OIL BEETLE. SHE HANGS AROUND A FLOWER HEAD UNTIL A BEE SHOWS UP, THEN HOPS ABOARD FOR A RIDE TO THE BEE'S CELLS, WHERE SHE DEPOSITS HER PARASITIC EGGS!

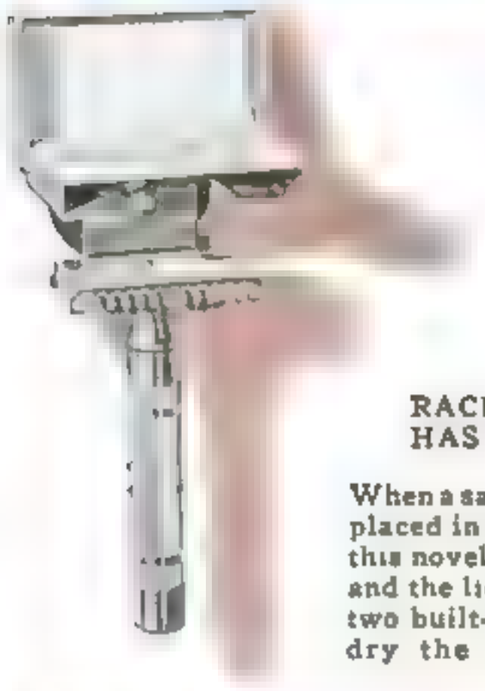
THE AMERICAN **LOBSTER** IS A CREATURE OF QUEER HABITS! IT SHEDS NOT ONLY ITS SHELL, BUT EVEN ITS ESOPHAGUS, STOMACH, AND INTESTINAL LINING. ANOTHER THING — SOME LOBSTERS ARE RIGHT-HANDED, OTHERS LEFT-HANDED, DEPENDING ON THE SIDE THE HEAVY "CRUSHER CLAW" GROWS ON! AND IF HE GETS INTO TROUBLE, THE ODD CRUSTACEAN CAN AMPUTATE ONE OF HIS CLAWS AND GROW ANOTHER IN ITS PLACE!

Handy Aids *for the* Homemaker

CUBE STARCH IS EASILY MEASURED

Made in the form of cubes about the size of lump sugar, **a** new starch **makes** it easy to secure uniformity of stiffness in starching laundry. The starch is packed in one-pound boxes, each **of** which contains eighty cubes

RUBBER CONTAINER COVERS. Specially designed for covering left-over food in jars and bottles when placed in refrigerators, these washable rubber caps come in sizes to fit standard types of containers

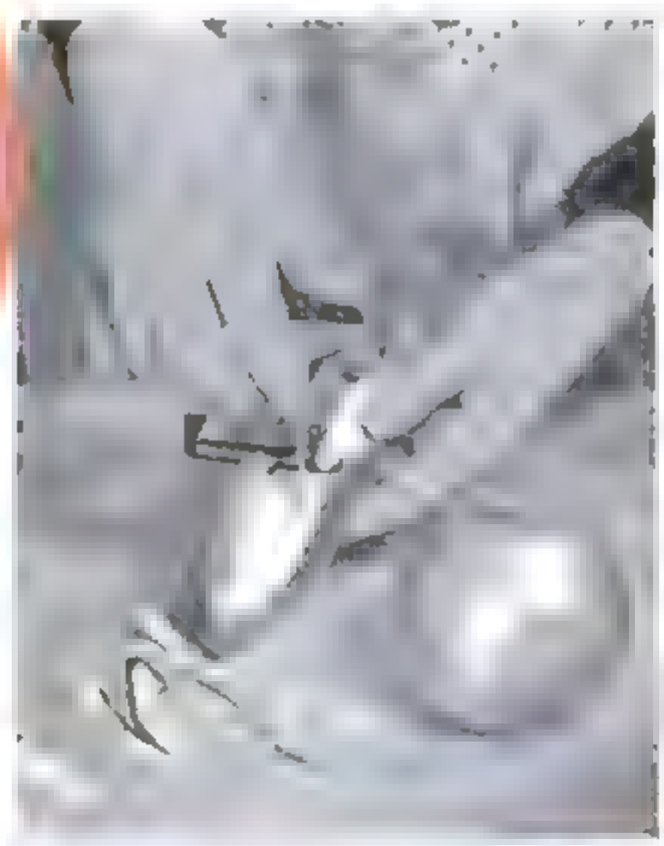


RACK FOR RAZOR HAS BLADE DRIER

When a safety-razorblade is placed in the drying unit of this novel bathroom fixture, and the lid is pressed down, two built-in absorbent pads dry the blade instantly

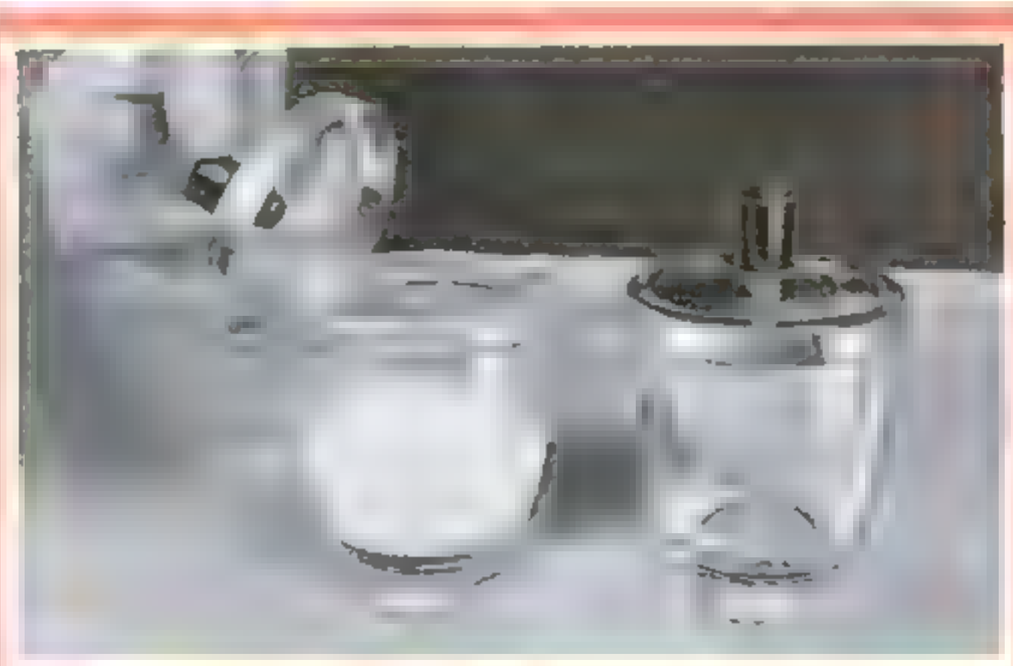
COFFEE MAKER FITS ANY POT. Any coffee pot is a drip coffee maker when fitted with a new device consisting of a cloth bag attached to an adjustable metal frame. Coffee is placed in the bag and boiling water is poured over it

FRUIT AND VEGETABLE PEELER
With its blade set to take a very thin peel, the kitchen tool illustrated below is said to make short work of peeling fruits and vegetables, following the contours readily



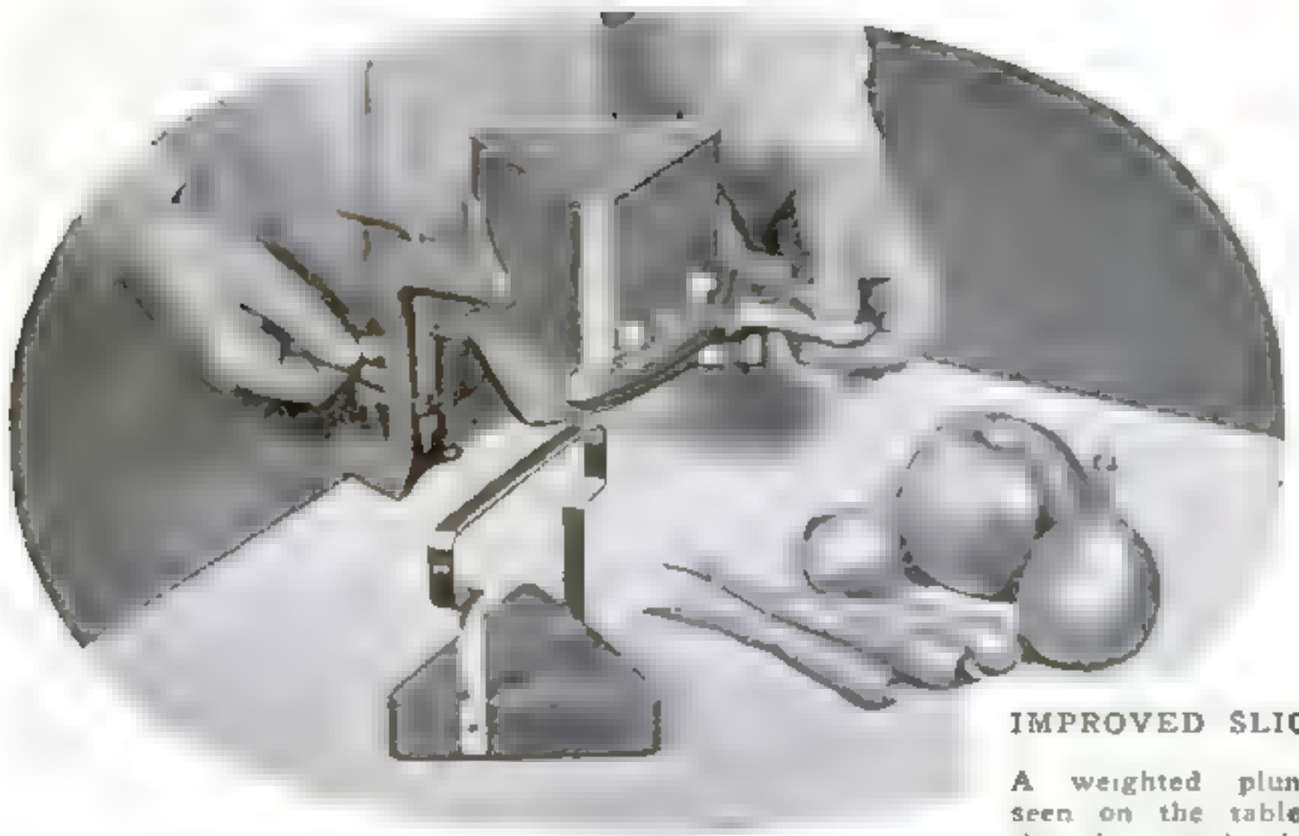
SPLASHPROOF COVER FOR DRY FRYING

A novel ventilating feature in the frying-pan cover shown above allows the moisture of evaporation to escape, and yet prevents grease from splashing out. This makes it possible to brown or dry-fry food with the protection of a cover



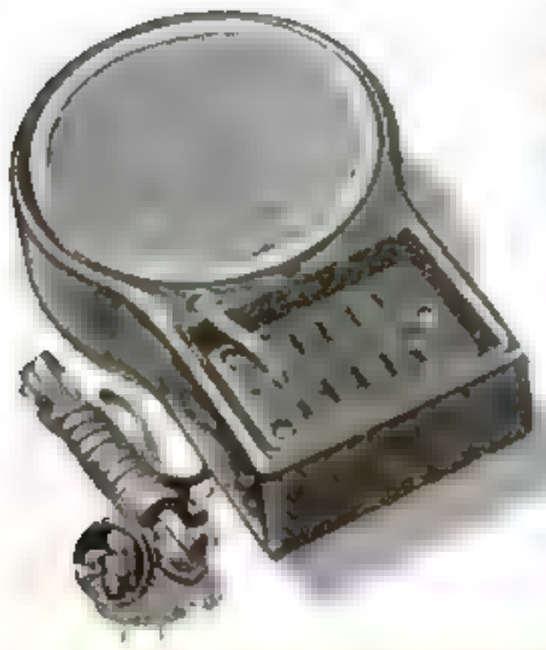
GLASS EGG CUPS RESIST HEAT

Eggs, custards, and other foods can be cooked in the heat-resisting glass cups shown at the left which are placed **directly in hot water. Because they retain heat, they** will **keep the food warm on an invalid's tray. Cups have metal covers**



IMPROVED SLICER

A weighted plunger, seen on the table in the photograph above, presses the vegetables down against the cutting blades of this slicer. The device is easily clamped to the kitchen table for use



ELECTRIC VAPORIZER DESTROYS INSECTS

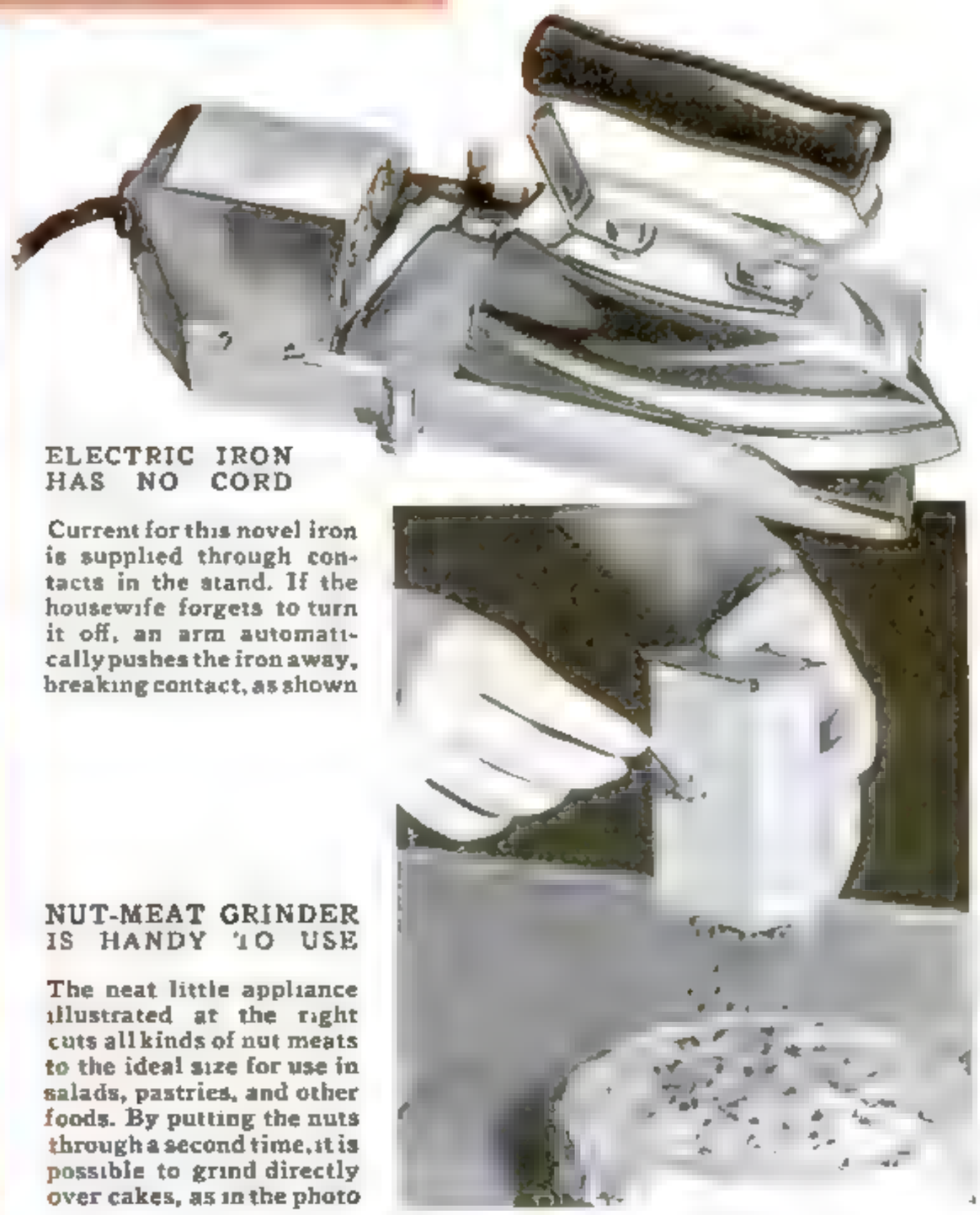
Plugged into any light socket, the appliance at the left diffuses an insecticide to kill flies and other pests

NORMALIZES HARD WATER

When a new chemical preparation is added to hard water, ordinary soap can be used in it without forming the usual lime curd. It is recommended for dish washing, laundry, and all other soap-using purposes

PLATE RACKS FOR SHELVES

The rack pictured at the left holds plates of any size, as the rubber grips are adjustable. Each unit is designed to hold a dozen plates, in a space-saving upright position



ELECTRIC IRON HAS NO CORD

Current for this novel iron is supplied through contacts in the stand. If the housewife forgets to turn it off, an arm automatically pushes the iron away, breaking contact, as shown

NUT-MEAT GRINDER IS HANDY TO USE

The neat little appliance illustrated at the right cuts all kinds of nut meats to the ideal size for use in salads, pastries, and other foods. By putting the nuts through a second time, it is possible to grind directly over cakes, as in the photo

MAN-MADE SPONGE AIDS IN WINDOW WASHING

Artificial sponges, made of cellulose and supplied with squared edges, are specially effective for window washing. They rinse easily and may be used for the same purposes as natural sponges

Mysteries of FIRE

shown by these easy HOME EXPERIMENTS

A phosphorescent compound made from citric acid crystals gives off light as it cools in an evaporating dish. This proves that light can be produced without heat

When a yellow Bunsen flame is cooled by inserting a sheet of metal, it is no longer luminous. If the metal is heated with another burner, as above, the yellow glow returns. Right, carbon particles from a candle flame turn a blue Bunsen flame yellow

By Raymond B. Wailes

THOUGH fire has been used for heat and light down through the ages, the true nature of a flame still holds mysteries. It was only a few decades ago that chemists began developing the modern conception of what a flame really is made of. While much remains, even today, to be learned by the research workers who are eagerly pursuing the subject, what they have found out thus far will be interesting to demonstrate in your home laboratory.

If you are accustomed to performing your chemical experiments with the aid of an alcohol lamp or an oil stove, and no supply of gas is available, you will not be unduly handicapped in your study of fire. In fact, many of the great historic experiments on flames were carried out with oil lamps or with candles.

Hold a lighted match or taper an inch or so above the smoldering wick of a candle, a moment after it has been extinguished, and you will see the flame travel down the stream of smoke and rekindle the candle. Early observers concluded, therefore, that a candle flame consisted merely of burning smoke.

We know, now, that the flame of a candle is not quite so simple as that. Actually, it is made up of burning hydrocarbon gases, or compounds of hydrogen and carbon, formed from the wax of which the candle is made

When a candle burns, the heat of the flame first melts the wax. The molten material travels toward the wick, as you can observe by dropping a pinch of charcoal or ground-up pencil lead upon it. Rising in the wick by capillary attraction, the molten wax is decomposed by the heat of the flame into combustible hydrocarbons. These cannot burn, however, until they come in contact with the outside air. The dark central portion of a candle flame consists of these unburned gases, as you can prove by inserting the end of a metal or glass tube in it. The gas issuing from the other end of the tube can be ignited.

While they are escaping from the center of the candle flame, the hydrocarbon gases are further decomposed by heat into hydrogen gas and free carbon. Heated to incandescence, the floating carbon particles give off light. That these particles are present in the luminous mantle surrounding the central region of the flame may be shown by inserting a cold object, which immediately becomes covered with soot. Another way to show their presence is to interpose a lighted candle between a 100-watt electric lamp and a sheet of paper. The flame of the candle, due to the solid material it contains, casts a distinct shadow on the paper!

As the combustible materials in the candle flame finally encounter a sufficient supply of oxygen at its outer boundary, they are completely consumed. Carbon dioxide and water are the final products. The flame is thus seen to be the result of a succession of chemical reactions, ending in complete combustion.

A Bunsen burner, which mixes gas with air drawn in through holes at its base, offers other types of flames for experiment. Close the air ports to shut off the air supply, and the gas will burn with a luminous, yellow flame resembling that of a candle. The resemblance is not surprising, since the yellow burner flame also contains incandescent particles; like a candle flame, it will deposit soot on cold objects. As the air ports of the Bunsen burner are opened, a point is reached where the carbon particles are no longer formed, and the yellow tinge disappears. The flame takes on a blue color and separates into an inner and an outer cone. The burners of a gas stove, like your Bunsen burner, use just such a flame because of its heating efficiency and its freedom from soot.

Thrust a tube into the middle of the blue Bunsen-burner flame and, as with a candle, you can light the gases emerging from its end. The central part of the inner cone, which you are tapping, consists of unburned gases mixed with air. It is relatively cold; a match head quickly inserted and held in this center-core region

Your Familiar Bunsen Burner Is, In Itself, A Miniature Laboratory In Which To Study the Secrets of Combustion

• •

of the flame will not be set afire.

A good way to observe the relative amounts of heat liberated in various parts of the two-cone flame is to hold a sheet of ordinary paper in it momentarily, both horizontally and vertically. If the paper is inserted and withdrawn rapidly, the charred marks will give a clear picture showing which parts of the flame are the hottest. Asbestos paper, if available, will work still better, and plaster board may also be used.

YOU can actually take a Bunsen flame apart, so that you can examine its structure more easily, with the aid of a simple homemade device. You will need a section of glass tubing, just large enough to make a secure joint when it is slipped over a strip of friction tape wrapped around the stack of your Bunsen burner; and a straight-sided lamp chimney, such as may be obtained at many five-and-ten-cent stores. Support the latter by means of a flat, wide cork encircling the inner tube, as shown in an accompanying diagram; the hole in the cork should be of a size that permits the lamp chimney to be slid up and down as desired. Such a device is known as a Smithells' flame separator.

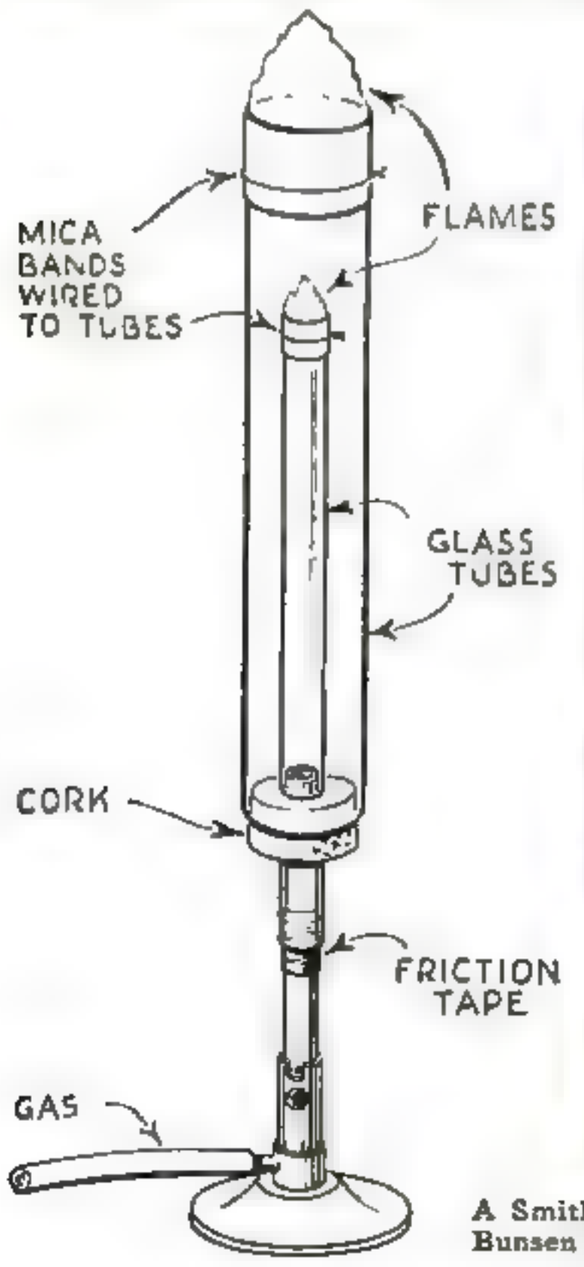
Adjust the device for use by raising the outer cylinder so that its top projects above that of the inner tube. Now close the air ports of the Bunsen burner and turn on the gas. Light it at the top of the outer tube, and you will observe a typical yellow, luminous Bunsen-burner flame.

Now start opening the air ports of the burner. The yellow color of the flame grows fainter. With the air ports wide open, the flame becomes blue and travels downward, burning at the open end of the inner tube. Flame still persists, however, at the mouth of the outer tube as well

The arrangement is a perfect reproduction of the blue Bunsen flame, divided into its component parts. Its inner cone is represented by the flame from the inner glass tube. The flame at the outer tube corresponds to its outer cone. Lower the lamp chimney while the two flames are burning, and they will come together and form the ordinary two-cone Bunsen flame.

If the lamp chimney and the inner tube are not made of special heat-resisting glass, it will be desirable to protect them from the heat of the flames burning at their mouths. This may be done by wiring a lip of mica or asbestos paper to the outer rim of each one, as indicated in the diagram.

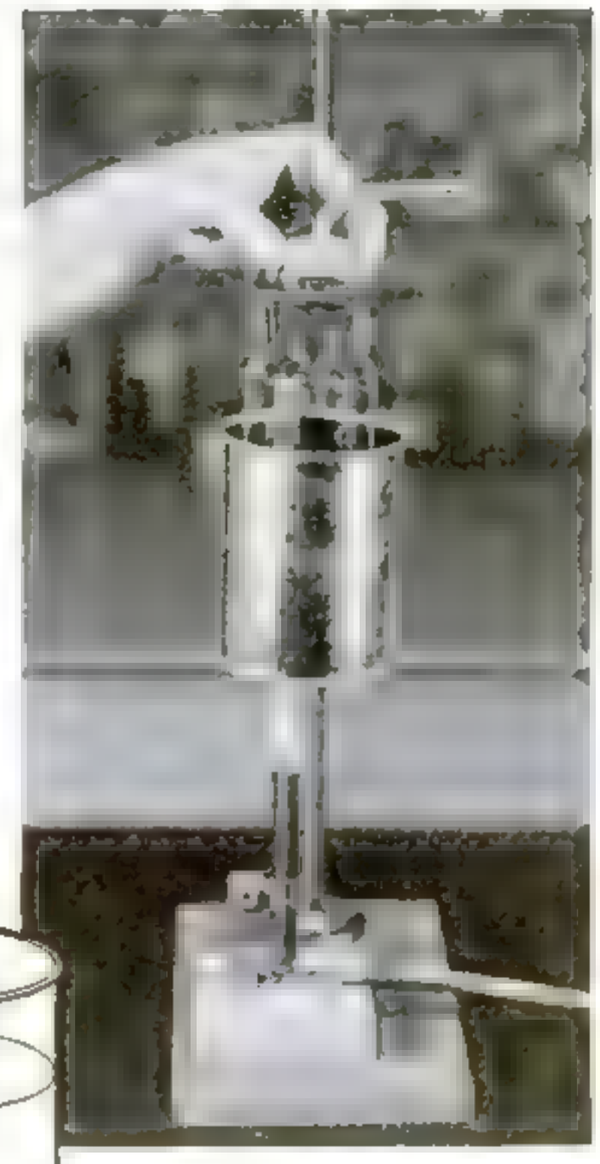
The innermost part of a Bunsen flame —unlike that of a candle flame—contains both combustible gas and air for its combustion. Why doesn't the gas burn within the inner cone? The answer lies in the stream of gas and air coming up the burner stack, which pushes away the gases already on fire faster than the flame can travel backward against the gaseous current. The speed at which combustion can spread, however, increases with the proportion of air in the gas-air mixture until, with the air ports opened widest, it may exceed the velocity of the supply stream. When this happens, the flame travels against the stream, descending the stack of the burner and burning at its base. The burner then is said to have "struck back." It should be extinguished at once and adjusted properly before relighting, since this abnormal mode of combustion is incomplete and releases objectionable vapors, including *(Continued on page 112)*



A Smithells' flame separator dividing the two distinct cones of a Bunsen burner into separate flames. The drawing shows the set-up

Water Bath for Gentle Heating

IN EXPERIMENTS where chemicals must be heated gently a homemade water bath will prove handy. It permits an ordinary bottle to be used as an inexpensive substitute for the chemical flask, which would be required if the heat of the flame were applied directly to the glass. The container is a tin can, filled with water and provided with a support on which the bottle rests. This support may be a coil of metal ribbon, or a cross-shaped piece made by fitting together two flat strips of metal as shown. It prevents violent bumping that might otherwise tip over or disarrange your apparatus, allowing bubbles of steam formed on the bottom of the can to escape. A few strips of paper placed in the can along with the water will char and warn you by their burnt odor if the water bath goes dry. This warning gives you sufficient time to shut off the heat and refill the bath with water before the rising temperature cracks the bottle. In the experiment shown in the illustration, the water bath is being used for generating hydrogen gas from scraps of aluminum and a solution of lye.



With this homemade water bath you can use ordinary bottles for gentle heating Here it is being employed for generating hydrogen gas

Novel Tests of Scientific Laws

Putting Physics to Work On the Ball Diamond

If you hold a baseball bat loosely by one end and shake it rapidly back and forth, you will observe that one point near the thick end shows very little motion, as illustrated by the photograph above. This point is called the "center of percussion" and is the place where the ball should be struck in order to give the least shock to the hands. The location of the point is determined by the distribution of weight in the bat, and is approximately the same as its center of gravity. For this reason, a blow struck there will produce minimum vibration.

Bits of Camphor Dance on Water To Make Sensitive Oil Detector

Drop some small pieces of camphor into a dish of water, and they will immediately start spinning and darting in all directions. Put the end of your finger in the water, and in a few seconds the motion will stop. Draw a sheet of paper across the surface of the water, and the camphor will start its dance again. This mystifying behavior is explained by the fact that the surface tension of the water around the camphor is weakened, and the stronger surface tension of the remaining water pulls it around. Oil from the skin of the finger stops the motion, while the paper removes the oil.

Wire and Magnet Make A Simple Motor

Push a bar magnet through a circular cardboard box top and pour some mercury around it as illustrated at the right. A stiff wire suspended from above and dipping into the mercury will move around and around the magnet when an electric current is passed through it as shown. The motion is caused by the interaction between the magnet's field and that set up by the current in the wire. If the magnet's north pole is upward, and the current flows down through the wire, the latter will move clockwise around the magnet.

Gyroscope Must Wabble To Produce Stabilizing Effect

A gyroscope top, mounted on a two-wheeled car as shown at the left, will balance the device on a string—but only if it is free to tilt forward and backward. If the bolt that holds the top to the frame is tightened, the car promptly falls over. This demonstrates why gyroscopes used as stabilizers in ships must be free to wabble or precess, as the movement is called, at right angles to the motions set up in the body they are intended to control.

Cleaning Fluid Bursts a Balloon

Allow a drop of carbon tetrachloride, commonly used as a cleaning fluid, to fall on a rubber balloon that has been inflated with air. In a few seconds the balloon will burst. The explanation of the explosion is that the fluid is absorbed by the rubber, causing a weak spot in the balloon.

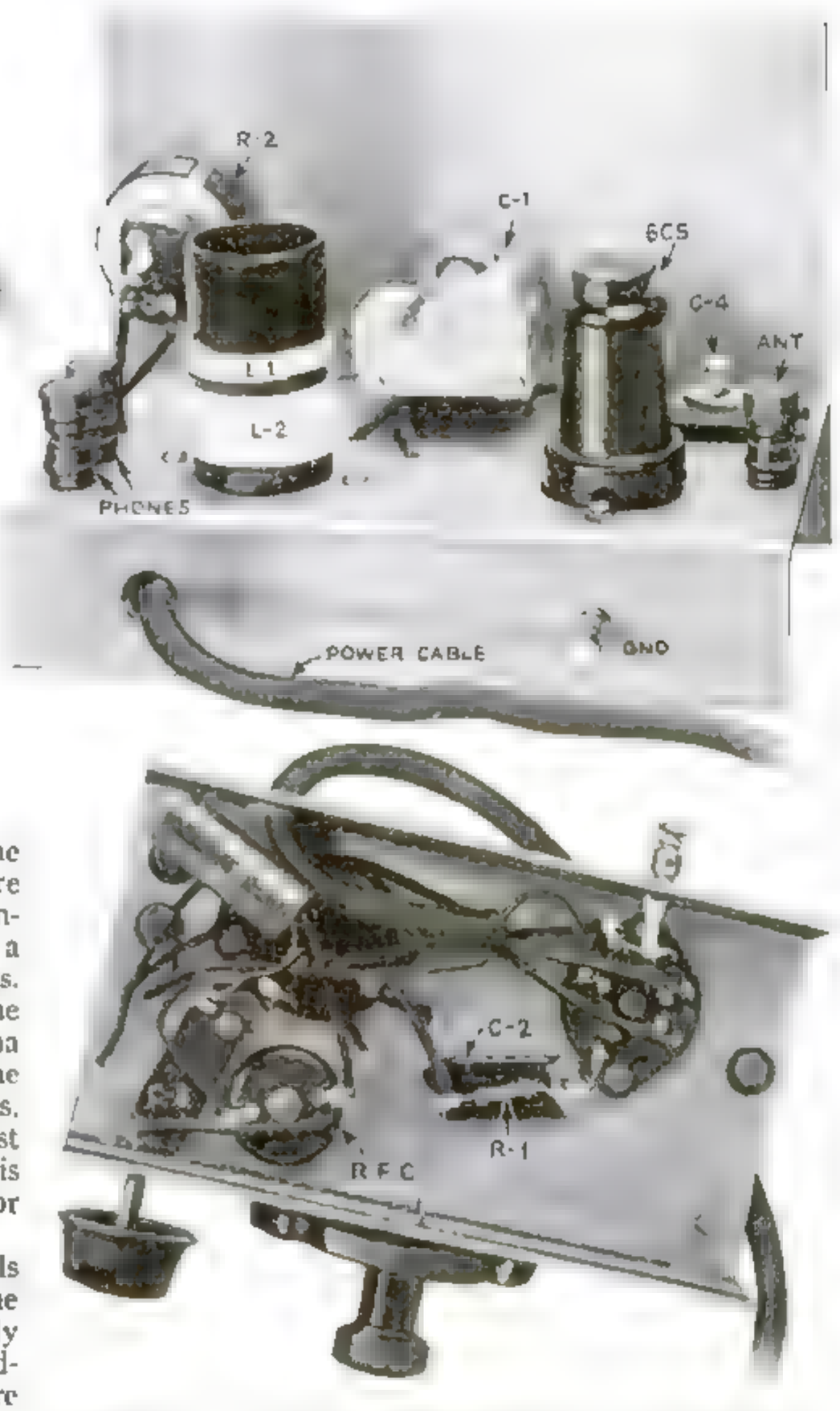
Test Proves Principle Of Movable Pulley

Rig a weighted platform with a pulley as shown at the right. When the rubber band on the end of the string is held in the fingers, it stretches only half as far as when it is looped over the projecting screw on the upright piece. In the first instance, the weight is equally divided between the two ends of the string; in the second, the whole load is placed on the rubber band. The left-hand picture represents an application of the single movable pulley, which, in the language of physics, gives a mechanical advantage of two—that is, halves the pull required to lift the load.

FIVE DOLLARS BUILDS THIS

Metal-Tube Receiver

By STANLEY JOHNSON



TWO-TUBE SERVICE FROM ONE TUBE

The author using the set described in this article. The rear view of the chassis, at right, shows how only the variable resistor and variable condenser are mounted on the panel, small parts being underneath as seen below

ALTHOUGH this short-wave set uses only a single metal tube, its volume and sensitivity equal that obtained with many more-complicated circuits.

Operated in the writer's home in central Nebraska, the compact receiver brings in amateur, police, air-mail, and commercial short-wave stations all over the United States with excellent headphone volume. With careful tuning, foreign stations also are heard in spite of the fact that its short forty-foot antenna is located in the midst of a noisy business district.

Complete, including the tube, the receiver cost less than five dollars to build and is so simple that a beginner can assemble it easily. Its single type 6C5 metal tube is used in a simple regenerative circuit; regeneration being controlled by a 500,000-ohm variable resistor. To eliminate hand capacity and inductive hum, as well as to add to the appearance of the set, the parts are mounted on a small metal chassis and panel.

The chassis, which measures 1½ by 3¾ by 7 inches, can be cut from a standard seven by twelve-inch aluminum panel sheet. The five by seven-inch panel, which is bolted to the front of the chassis, can be cut from the metal left over from the chassis.

The variable resistor (R_2) and the variable condenser (C_1) are the only parts mounted on the panel. The mica trimming condenser (C_4), coil socket, tube, and the binding posts are mounted on the top of the chassis. The radio-frequency choke (RFC) and the fixed mica condensers (C_2 and C_3) are bolted to the under face of the chassis, while the paper by-pass condenser (C_5) and the grid resistor (R_3) are supported by their short leads.

The wiring will be greatly simplified if it is done with push-back, hook-up wire. Since this is a short-wave set, the various leads, especially the tuning leads, must be kept as short as possible. All connections should be carefully soldered. Although the chassis is grounded, it should not be depended upon to serve as a common return for the various parts which are grounded. To play safe, connect all grounded parts to a single point on the chassis. The binding posts for the headphones and the antenna should be insulated from the chassis with fiber washers. An uninsulated binding post on the rear of the chassis serves as the connection for the outside ground.

The receiver's plug-in coils may be purchased or if the builder prefers, he can easily wind them himself. Regardless of whether the coils are purchased or homemade, it is important that the prong and socket connections to them be made exactly as shown in the diagram. Homemade coils should be wound with No. 24 double-cotton-covered wire on 1¼-inch composition four-prong coil forms. The specifications given elsewhere will provide a set of coils covering the frequency range from nine to 170 meters. Of course, with larger coils, the set will tune to the broadcast band.

The simple regenerative circuit, using a single metal tube

A single forty-five-volt "B" battery furnishes the plate current for the set and the tube filament can be lighted by a 6.3-volt transformer, four dry cells connected in series, or a storage battery. Since the set draws very little plate current, an inexpensive light-duty "B" battery will give good service.

Once the set has been wired and checked, it should be tested with a good antenna and ground. The antenna should be at least forty feet long and the ground connection made, preferably, to a cold-water pipe. A few seconds after the set is turned on, it should begin to oscillate, as *(Continued on page 110)*

Flyweight Radio Set

USES NO "B" BATTERIES

By Arthur C. Miller

THREE tiny batteries form the complete power supply for the compact broadcast receiver illustrated. Through novel design and careful selection of parts, the necessity of using heavy "B" batteries is entirely eliminated.

Desiring a truly portable receiver that would not be weighted down with large batteries, the writer started several years ago to experiment with "B"-batteryless circuits. The result is an extremely simple two-tube regenerative hook-up devoid of fixed condensers and resistors as well as high-voltage batteries.

Complete, the circuit uses only nine commercial parts—a one-to-five-ratio audio transformer (T), an eighty-millihenry radio-frequency choke (RFC), a .00042 or .0005-mfd. variable condenser (C_1), a .0005-mfd. variable condenser (C_2), a type '30 tube, a type '49 tube, a four-prong socket, a five-prong socket, and a toggle switch (Sw). The two "pancake" tuning coils used (L_1 and L_2) can be made easily by any amateur in a few minutes and for a few cents. As shown in the drawing, they consist simply of fifty-five turns of No. 28 insulated wire wound on three-inch cardboard disks.

The layout of the parts is important. It is particularly important, for instance, that a composition, rubber, or wood panel be used. Metal, however, can be used for the shallow chassis. The switch, two variable condensers, and two tuning coils should be mounted on the panel; the transformer, tubes, and choke on the chassis. Keep all leads as short as possible.

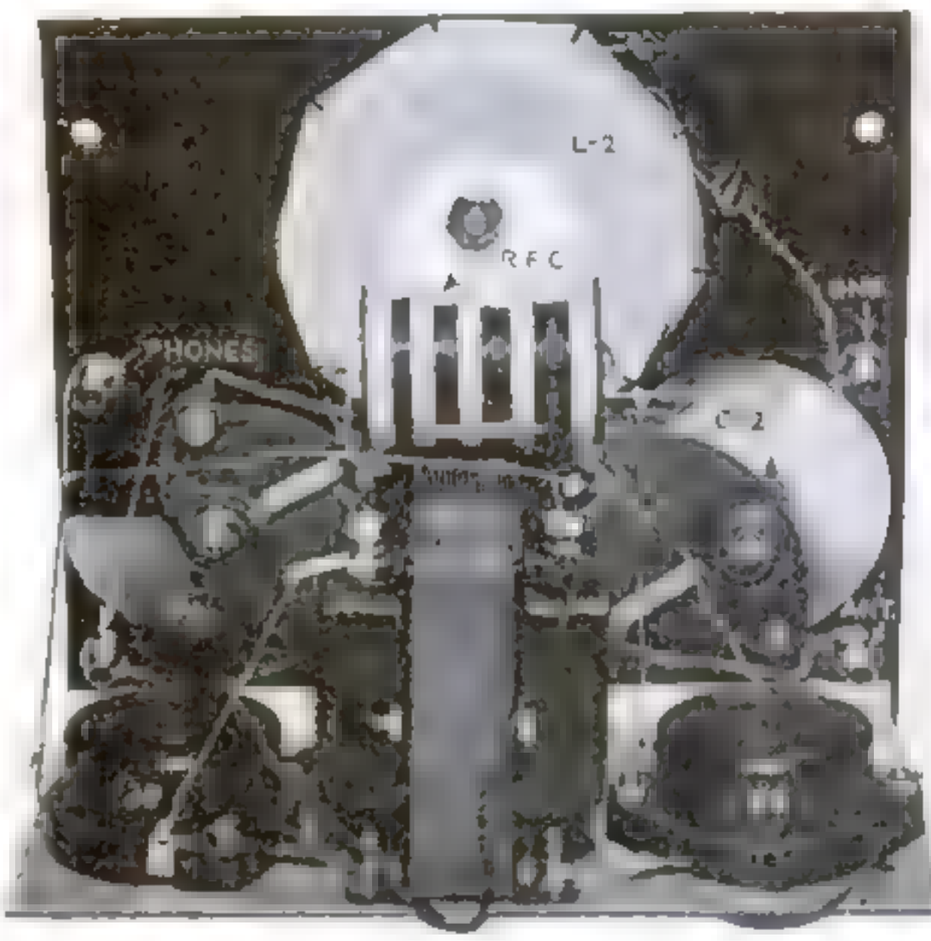
When wiring the circuit, pay particular attention to the '49 tube. As shown in the diagram, the connections to the screen grid and the control grid are reversed from their conventional order.

For the power supply, one small-size, 1½-volt dry cell and two 4½-volt "C" batteries were found to provide the most efficient and compact combination. How these are connected to supply the filaments and plate circuits of the type '30 and '49 tubes is clearly shown in the diagram.

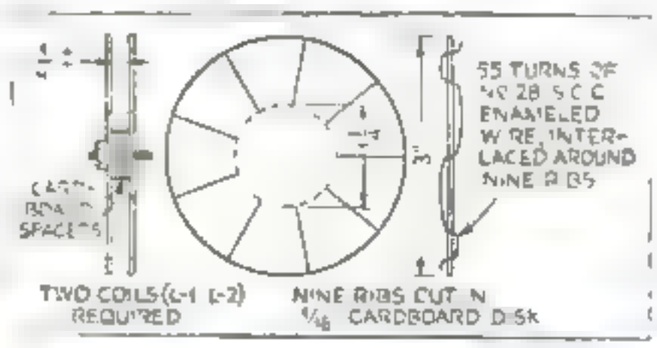
For a regenerative circuit, the receiver tunes with surprising smoothness and without the troublesome overlapping of stations generally experienced with the simpler broadcast hook-ups. The logging is sharp and the stations well spread over the dial. As for the regeneration, it takes place so evenly that one is hardly conscious that it has occurred. The characteristic "plop" is missing almost entirely.

Best results have been obtained when the receiver was connected to a well-insulated, fourteen-foot antenna and a good ground. In fact, when a longer antenna was tried it was necessary to use a trimmer condenser in the antenna lead. In tests, with a twelve-foot indoor aerial and no ground, more than fifty stations were logged in the course of a few months, some of them from a distance of 1,500 miles.

Mounted in this neat carrying case, the set is ideal as a portable

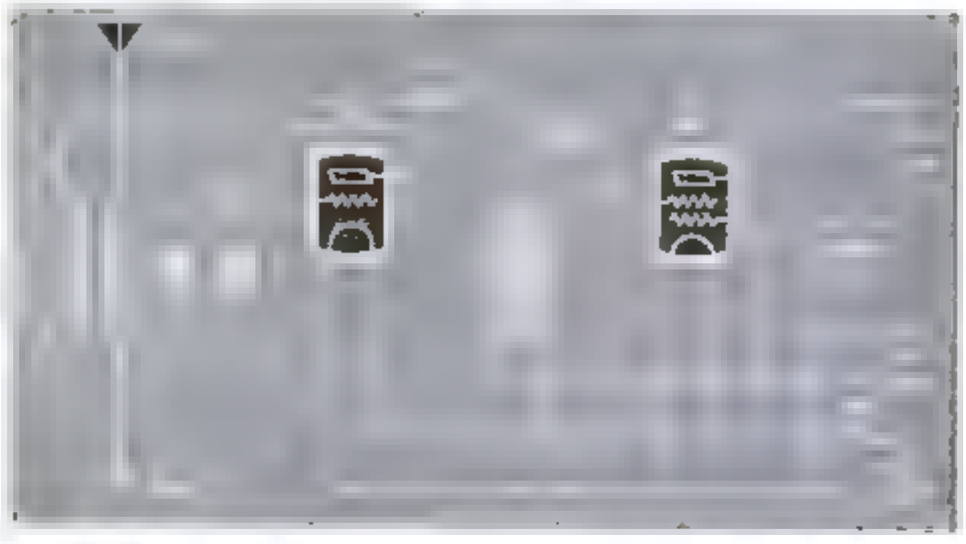


How the nine commercial parts are mounted. The panel must be made of composition or other nonconducting material



DIRECTIONS FOR COIL WINDING

The pair of "pancake" tuning coils used can be made easily by any amateur. As shown at left, they are wound on cardboard disks



Simplicity of the hook-up is apparent in this circuit diagram

Below, the shallow chassis is removed from the cabinet. Note the three small batteries that form the power supply

SIX NEW HELPS FOR

Radio Builders

Novel antenna fastened to side wall of a house

"Porcupine" Antenna Is Easily Installed

CONSISTING of a clump of short wires that resembles a porcupine or a bristle brush, the latest in novel antennas requires no masts, insulators, or dangling wires. It can be mounted easily on the side wall or roof of a house. Where space is at a premium, it can be fastened to the outside frame of a window. It is said to operate equally well for short-wave or broadcast-program receiving.

Nonskid Powder Ends Dial Slipping

RADIO dials of the friction-drive variety sometimes develop a tendency to slip, particularly after several years of continued use. With a new nonslip powder, however, slipping can be kept at a minimum even on the most troublesome unit. Dusted on the pulleys, friction wheels, or cables, it increases the friction without gumming up the moving parts. It is easily applied to the parts by means of a brush, as illustrated at the right.

New nonslip powder being applied to dial mechanism

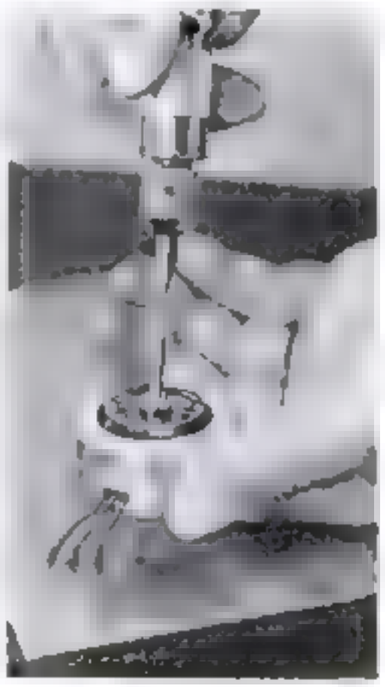
Treating a noisy contact with special lubricant

Lubricant Silences Noisy Contacts

NOISY and hard-to-operate radio contacts, such as all-wave switches and wire-wound volume controls, can be silenced and made to work more smoothly with a new lubricating compound recently placed on the market. It is simply applied to the contact surface with a toothpick or match stick and worked in by operating the control several times.

Cap Socket Simplifies Set Layout

FOR the radio experimenter who builds his receivers from the ground up, the "cap" socket illustrated eliminates the necessity of drilling large-diameter socket holes in metal chassis. It can be mounted with a single bolt, and the connecting wires led through convenient "knock-out" holes or through a small hole drilled in the chassis. Since the socket is mounted on top of the chassis, wiring changes and additions can be made easily.

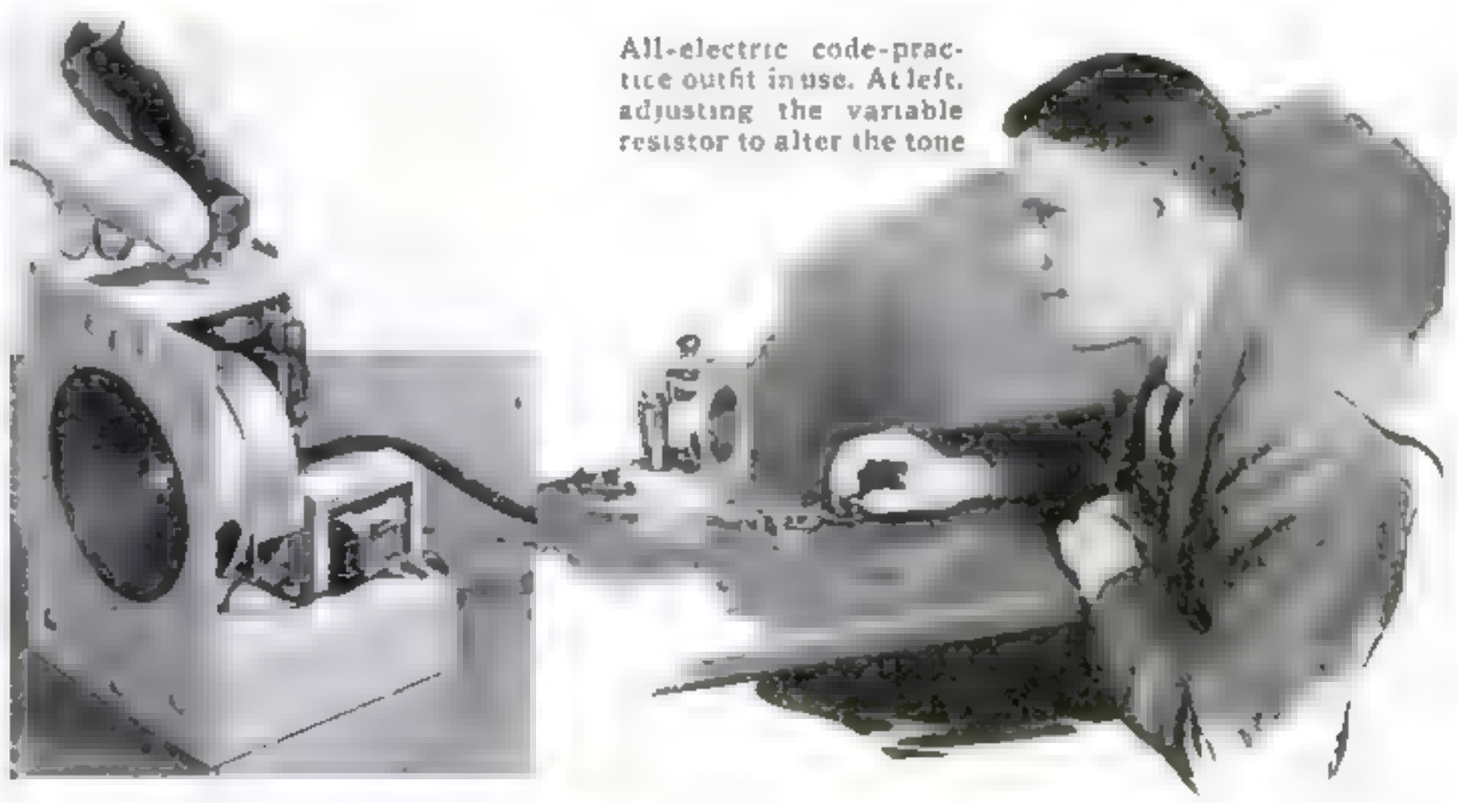


The socket is mounted on a chassis with one bolt

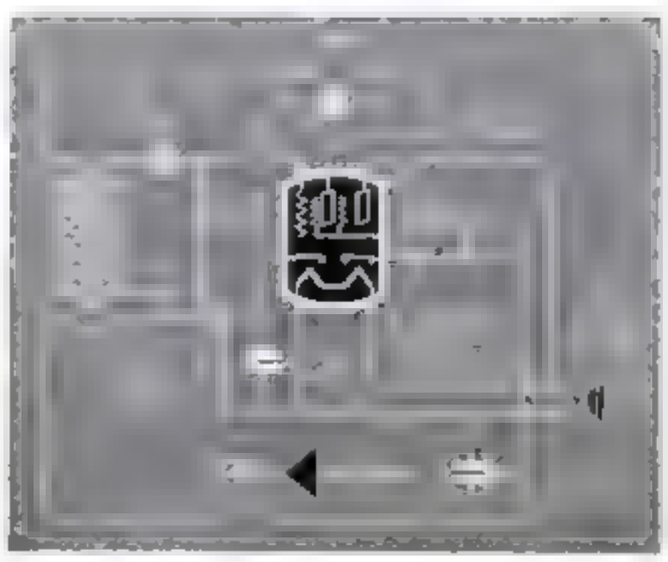
Soldering-Flux Dispenser

FROM a lipstick holder of the type that feeds out the contents when a knurled nut at the bottom is turned, you can make a handy dispenser for soldering paste. Simply remove the lipstick and fill the holder with the paste flux. When flux is needed, a twist of the knurled bottom will force out just the amount required for any job. The cap, with which the lipstick holder is equipped, will protect the soldering paste from dust and dirt while it is not in use.

Code-Practice Set Has No Batteries or Phones



All-electric code-practice outfit in use. At left, adjusting the variable resistor to alter the tone



The AC-DC audio-oscillator circuit used in the outfit. A loudspeaker replaces phones

DESIGNED to be plugged into any wall socket, and provided with a built-in midget loudspeaker, this compact code-practice outfit requires neither batteries nor headphones. The circuit, an AC-DC audio oscillator, is built up around the familiar double-purpose 12A7 tube, as illustrated in the diagram at the left. Two binding post terminals provide convenient connections for the key, and a variable resistor mounted above the speaker makes it possible to alter the pitch of the note to suit personal tastes. The unit is ideal for members of radio clubs who wish to practice the code as a group, as well as for the use of the solitary student.

Trouble-Hunting

WHEN YOUR CAR WON'T RUN

"Here it is!" Blarsden exclaimed. "The bolt holding the ground cable to the frame is so loose it's just hanging on by its eyebrows. No wonder the current wouldn't flow fast enough to work the starter."

By MARTIN BUNN

"SOME wagon, eh, Gus?" young Blarsden bragged, standing back to admire the sleek lines and shimmering gloss of his brand-new automobile.

"Sure is," agreed Gus Wilson, half owner of the Model Garage, as he screwed the cap back on the fuel tank of the car and hung the nozzle of the gasoline hose in its place on the pump. With his partner, Joe Clark, on the sick list, and the boy away on a long errand, the veteran auto mechanic was temporarily on duty "out front."

Blarsden opened the car door and climbed in behind the steering wheel. "Well, so long," he said, pocketing his change. "You won't be seeing me around the shop any more, now that I've scrapped that old kettle I used to drive With this new bus, I'll just hesitate now and then to pick up some gas and oil."

Snapping on the ignition, Blarsden pressed his foot on the starter button. Nothing happened. He jabbed it down again, this time more vigorously, with the same result. "Now what the—" he muttered, looking helplessly toward Gus, who was just walking into the garage office. "Hey, Gus!"

A grin spread over the mechanic's grizzled face, as he turned and sauntered over to the car. "Well, well," he said, "if it ain't the young fellow with the troubleproof car. Back for oil and gas already? I know you don't need a mechanic for that fine new bus, but if I was you I'd 'just hesitate' long enough to find out why it won't go."

"Gosh!" exclaimed Blarsden, with a sheepish grin. "How do I begin? I'm no automobile expert."

"You don't have to be, to figure out why a car doesn't start, or what makes it stop suddenly," Gus replied. "It's just a matter of eliminating the things it couldn't be, then the things it's not likely to be, and the trouble will be among the things that are left."

"All right," said Blarsden. "I'm game. Let's see, now. It's a cinch that neither the carburetor nor the ignition system can have anything to do with it. The starter didn't turn over the motor, so the carburetor and ignition didn't have a chance to work. If the starter won't work it must be either because it isn't getting any juice or else because it's busted somehow."

"That's the way to go at it!" Gus applauded and waited for more eliminations.

Blarsden chuckled. "Regular Sherlock Holmes, Jr., I am. Now, if the starter isn't getting any juice, it must be that there is no juice in the battery, or something is preventing it from flowing to the starter when I press the pedal. The lights go on and the horn blows," he went on, testing them. "That means the battery isn't dead—and it isn't likely that it could be, seeing that the car is brand new. As far as I can see, that narrows it down to finding out whether the starter has gone west, or what's keeping the current from flowing through it."

"There you are!" Gus grinned, leaning up against the pump. "Not very hard, is it? Now, just remember that whenever you get it down to deciding whether to blame the trouble on a defective electrical instrument or on the wires that feed it, always investigate the wiring first."

"Here goes," said Blarsden, scrambling out of the car and pulling up the floor mat, "I'll start with the battery connections."

A few minutes later he exclaimed: "Here it is! The bolt holding the ground cable to the frame is so loose it's just hanging on by its eyebrows. No wonder the current wouldn't flow fast enough to work the starter!

"You know, Gus," he continued, as he applied a wrench, "I like that idea of figuring out the trouble by first deciding what it can't be. Seems more logical, and saves time."

"It'll save you money, too," Gus commented. "Especially if you learn easy ways to fix the things that are most likely to stop a car on the road. Then you won't have to call a service car.

"I should think that might be kind of hard sometimes," Blarsden suggested. "If the car just stops suddenly without any warning, how would you go about figuring what was the matter?"

"That depends on how it stops," Gus said. "Of course, if the motor kept on running and the car just coasted to a standstill, it would have to be something broken in the drive to the rear wheels; either the drive shaft or one of the axles. There wouldn't be any quick way to fix a break like that. All you could do would be to phone for a tow car. If the car was equipped with an automatic clutch, it might be that something had gone wrong with the mechanism that made it pull out the clutch, and kept it that way.

"But I suppose," Gus continued, "you mean cases where the motor lays down on the job. Let's see," he pondered, counting on his huge fingers, "a gasoline motor has to have gas, oil, water, air, and electric sparks to make it run. If there was gas in the tank and in the carburetor, then it couldn't be lack of gas unless the carburetor jets were clogged with dirt or blocked with water.

"If the crankcase gauge showed oil, then it couldn't be lack of oil and, besides, when the oil gives out, a bearing usually burns out and there's a gosh-awful clanking before the motor stops. Lack of cooling water will stop an engine, but then the radiator would be steaming. It's a cinch to check on the air supply. If the carburetor air *(Continued on page 114)*

THE HOME WORKSHOP

Designed from
original Government plans
especially for
POPULAR SCIENCE MONTHLY

By

CAPT. E. ARMITAGE McCANN

HOW TO BUILD A SCALE MODEL

Coast Guard Patrol Boat

...*Smartest Looking Power Craft Afloat*

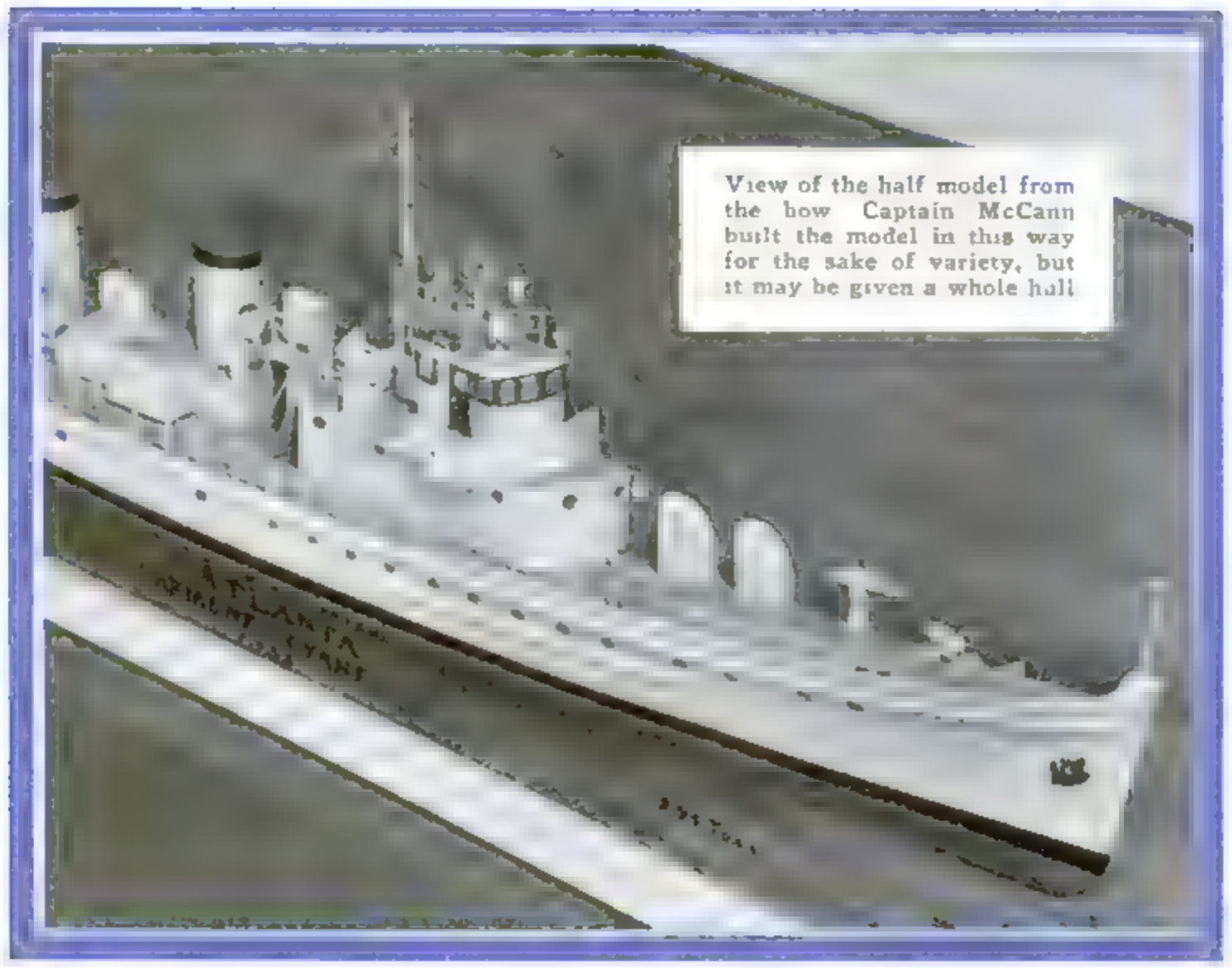
THE smartest looking power-driven craft afloat, to my mind, are the new 165-ft. United States Coast Guard patrol boats. President Roosevelt uses one of them, the *Potomac* (originally named the *Electra*), as a yacht. They make such attractive models that they should appeal to every ship model maker who does not confine himself entirely to sailing vessels.

Plans for an accurate scale model of one of these patrol boats are given in the accompanying drawings. If you work from them carefully, your model will acquire the clean, swift character that makes this class of boat so distinctive. The model will also represent a government service that has had a fine record ever since its inception in 1790 as the Revenue Marine. Besides preventing smuggling and enforcing navigation laws, the men of this service, with their shore stations, power craft, and surfboats, render aid to all vessels in distress along shore, from yacht to liner, without respect to nationality or "reason why."

The Coast Guard was kind enough to give me plans of one of the 165-footers and permission to take photographs aboard the *Galatea* when she was in dry dock, so that I could build an accurate model. The particular set of plans from which I worked are for the *Atlanta*. The *Ariadne* and *Cyane* are practically identical, and there is but little variation in the whole of this class. The boats of the *Galatea* group have the after end of the deck house extended, full width (where our plans show a small shelter deck), with the antenna lead-in amidships and the life rafts, one on each after corner. Their bulwarks are 18 in. high from the first break to the forward davit; otherwise they appear to be the same as our plans.

By way of variation I made only a half model fastened to a board (as shown in the photographs), but the plans and instructions are for a full model so that you can make whichever you wish. The half model is workmanlike and good looking and has the advantage of hanging on the wall instead of taking up space. It is considerably more than half as much work as a whole model. I mounted it on a five-ply walnut faced panel, but any panel that will not warp will do. It will be understood in the following that for the half model only one half of everything on the midship line is required, although for such parts as the gun, bell, whistle, compass, and lanterns, it is easier to make the whole and sink the unwanted halves into the panel.

Built to the scale of ⅛ in. equals 1 ft. of the original, the model is 20⅝ in. long. As on this scale she would draw only about ¾ in. of water, she is much too small for electric or steam power.



The hull is built of five layers of ½-in. pine dressed to 7/16 by 3¼ in. at the widest point. Ship lines are usually drawn parallel to the water line, but for easy construction ours are parallel to the keel. The deck line cuts through the top lift into the second, but as the deck is to be painted this will not matter. Be careful, however, that the two lifts are well glued together.

In the usual manner, cut the lifts or layers to the outlines given in the breadth plan. Mark the fore-and-aft center line and cross construction lines, bringing them over the edges. Glue the lifts together, mark the level of the deck at the sides, and mark the midship deck line from the inboard profile drawing. Shave down to the latter and then give the deck its camber or slight downward slant to the deck lines marked at the sides.

Cut the bow and stern profiles and shave away the sides until templates made from the body plan will fit at their respective stations. The stern is round from about halfway between *c* and *d* to the bulwark; the stem has a knife-edge from station I to between *b* and *c*, and from there up is rounded very slightly. The skeg is a flat piece ⅛ in. thick fitted to the keel. The keel is just a flat plate, so does not show.

The iron bulwark on the real vessel is set in on the deck 4 in. from the hull side amidships. This set-in tapers to nothing at the ends, and the molding is just a narrow ribbon of iron (see detail). This is difficult construction, especially in wood, so I got much the same effect by setting a 1/16-in. thick bulwark in a rabbet in the hull to come flush and adding a 1/16-in. square molding immediately below the deck line. The molding tapers to nothing near the stem. The bulwark piece needs steaming at the ends. The stem is quite tricky, but I got the shape by bending the bulwark sharply with round-nosed pliers and finished the shaping with a file. A solid piece could be set on the deck as far back as the half-round, horizontal plate and cut to shape, if preferred.

Half an inch below the deck line there is a rubbing strake. It is a full 1/16 in. by a scant 1/16 in. in cross section. Between the deck line and strake is a line of air ports, or lights, ⅛ in. in diameter. They have no visible rims, so I punched them out with a piece of tube filed to a sharp edge. A dental burr or small abrasive wheel cleans them out neatly. They should not be more than 1/32 in. deep. After the final painting of the hull, I cleaned them up, streaked them white and blue to rep-

Breadth and sheer plans with the various layers or "lifts" indicated; body plan, and various details. The scale in inches is given on facing page

Deck house, pilot house, and forward funnel. The model is built on the scale of ⅜ in. equals 1 ft. and is unusually realistic

resent the sky reflection, and varnished them to give a glassy apearance.

The hawse pipes for the anchors are ⅛-in. diameter and should be bored from both ends. The rims, top and bottom, can be a plastic composition or cardboard glued on and filed to shape.

The side ladders I made by soldering thin wires across thicker wires, with the top ends bent over the bulwarks and stuck into the deck, and the lower ends stuck into the hull. Another little iron ladder, which is required to lead to the top of the pilot house on the port side only, can be made at the same time; it is similar but narrower.

The propeller assembly can now be made. Note that there are twin rudders; these are connected inboard with a yoke. The rudder, sternpost, and strut are of thin metal. The rudders I made double, folded them over, set a rod in the bend at the top for the rudderpost, and soldered the two parts together; I then cut notches in them as shown, large enough to take the gudgeons (bearings) formed on the sternpost. The latter is a similar piece of metal, folded over but not sharply, with two extending strips which are bent into circles. A wire goes up in the rudder through them, forming the hinge pin.

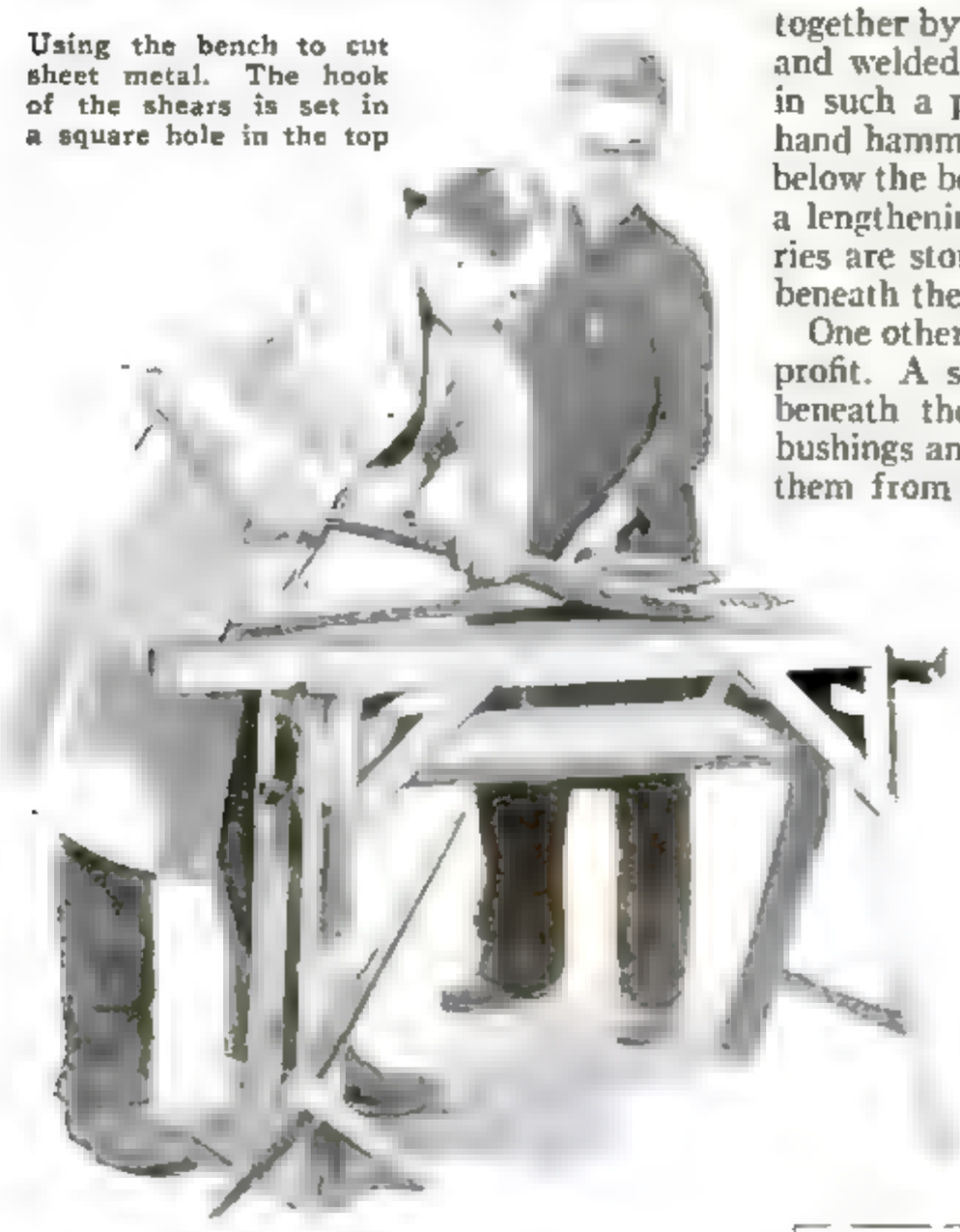
Each propeller shaft is a piece of rod about 1 16 in. in diameter and 2 in. long. The shaft tubing is a piece of tube to fit neatly on the shaft. The three-blade propeller can be bought or cast or built up by soldering a piece of tin, cut to shape, on a piece of tube, both being soldered to the shaft. In the *(Continued on page 94)*

KEY TO DRAWINGS

1. Deck house
2. Deck-house roof
3. Pilot house
4. Pilot-house roof
5. 6. Engine-room casing
7. Funnels
8. Companion hatches
9. Whistle
10. Searchlights
11. Bell
12. Radio compass
13. Standard compass
14. Running lights
15. Life rafts
16. Flag locker
17. Antenna lead in
18. Emergency generator
19. Ventilator
20. Gun, 3 in.
21. Gun, one pounder
22. Escape hatch
23. Access trunk
24. Fuel-oil vent
25. Fuel-oil filling
26. Ventilator set
27. Vents
28. Chocks
29. Bitts
30. Boats
31. Strong backs
32. Davits
33. Skids
34. Life buoys
35. Fire extinguishers
36. Life-belt boxes
37. Collision mats
38. Vegetable locker
39. Boat gear boxes
40. Windlass
41. Chain compressor

The outboard and inboard profiles of the *Atlanta*, a sectional view, the propeller arrangement, and details of the guns, boats, and other parts

LABOR-SAVING BENCH FOR METAL WORK



Using the bench to cut sheet metal. The hook of the shears is set in a square hole in the top

together by welding. Sockets made of pipe and welded to simple brackets are bolted in such a position that the heads of the hand hammer and sledge they hold will be below the bench top, out of the way. Snips, a lengthening handle, and similar accessories are stored in the long horizontal tube beneath the top.

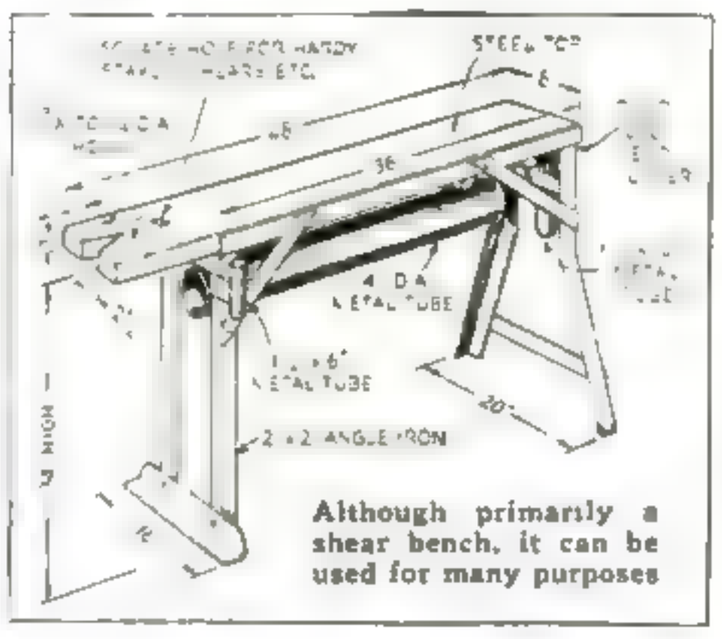
One other accessory might be added with profit. A small removable bin bracketed beneath the projecting end would catch bushings and pins punched out, preventing them from falling to the floor.—E. L.

We pay for good SHOP IDEAS

SEND us your best shop kinks and short articles like this one on a shear bench. Payment is made upon acceptance for all material that proves available for publication. Good photos or sketches are, of course, essential.

THE massive top and ample base of this metal-working bench make it very rigid in use, without the necessity of bolting it down. The notch facilitates pulling gears and pressing out bushings; the small holes are useful in punching pins from assemblies; the square hardy hole takes the hook on the shears handle and also supports various stakes for sheet metal working.

Any ordinary metal shop has materials in the scrap bin or junk heap to build a bench of this type. Note that the top rests in the upper angle irons, which are tacked



Although primarily a shear bench, it can be used for many purposes

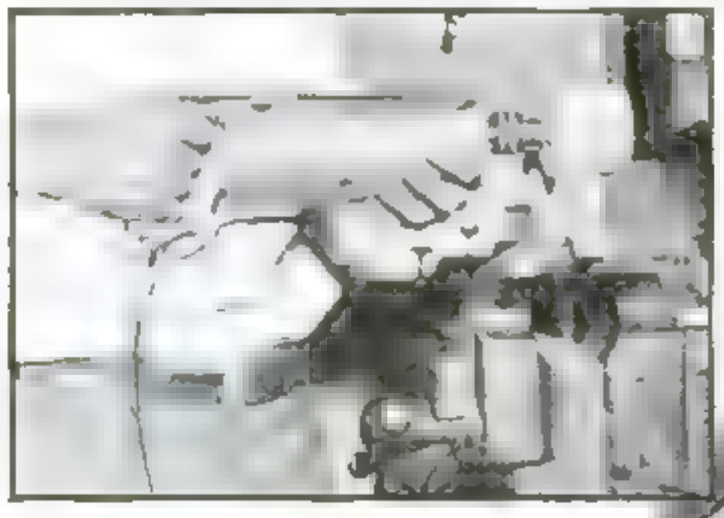
SPECIAL SANDING DRUMS QUICKLY MADE

SANDING drums are a useful addition to woodworking equipment. Driven by an electric drill or a flexible shaft, one of them will serve as a portable sanding machine. When chucked in a drill press or lathe, it can be used to shape any concave surfaces of table legs and similar parts.

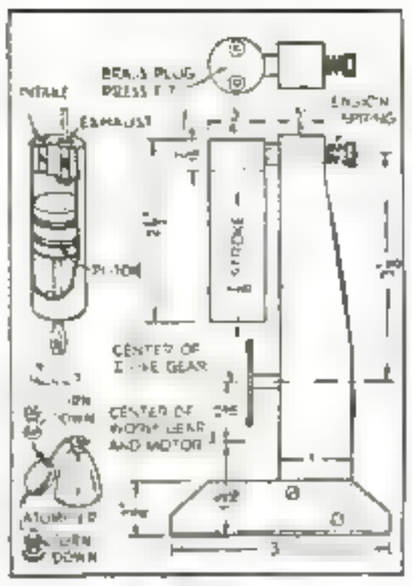
Drums of several sizes are often required to suit varied needs. Simply turn a drum to the desired size, drill a center hole, tighten a bolt in place, and true up the drum in the lathe again by chucking the bolt extension. Cut a slot 3/16 in. wide and ½ in. deep in the surface of the drum as shown, parallel to the center line of the bolt. Prepare a wooden wedge the length of the drum, ⅛ in. thick and approximately ⅜ in. wide.

Cut the sandpaper ¾ in. longer than the developed surface of the drum. Insert one end in the slot and continue wrapping the paper around the surface. Tuck the extra length into the slot and then insert the wooden wedge between the two turned-in edges. Force the wedge toward the bottom of the slot. This last operation will tend to tighten the paper.

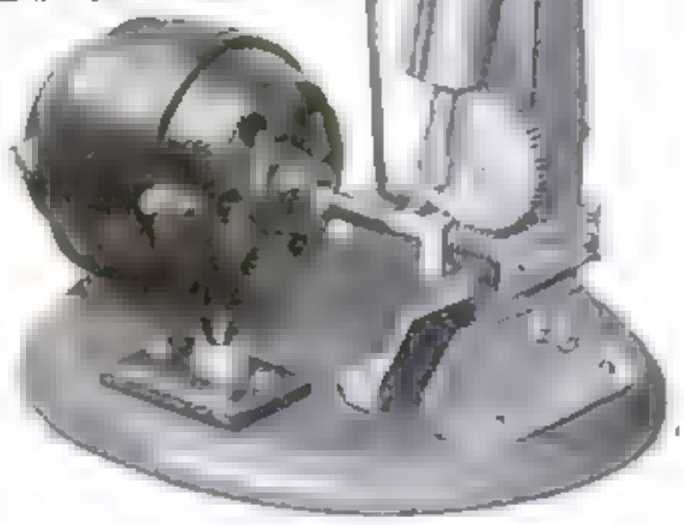
The writer has found that sandpaper fastened to a drum in this manner will stand high speeds without loosening. The worker can thus use regular sheet sandpaper, which is quite inexpensive, and at the same time make the drum any special size to fit requirements.—J. L. BIRD.



When a sanding drum is needed in some special size or for a particular job, one can easily be turned from wood and mounted on a bolt. Such a drum, chucked in a portable drill, is used as illustrated above



The finished air pump and, at left, a diagram showing the few dimensions that are important



HOMEMADE PUMP KEEPS AQUARIUM AERATED

POPULAR interest in tropical fish makes a small air pump for aerating an aquarium a useful project for the home workshop. If the builder has access to a lathe, the work is, of course, considerably simplified, but it can be done with the usual assortment of hand tools. Scraps of brass found in the junk box may be used, and tubing from an old bicycle pump or a brass pipe nipple will serve for the cylinder.

Dimensions are governed by the available material so only general figures are given in the diagram for the air pump illustrated. The machinist who likes to construct all the parts can make the worm and gear on the lathe; otherwise a factory product may be bought. A belt drive may be substituted, if preferred. It is a much simpler method. In case it is used, the cylinder can be inverted and mounted at the lower end of the support, and the crank, shaft, and pulley placed at the top so that there is enough clearance.

The piston in the model shown was turned out of brass with two grooves for packing, but the fit was close and the grooves were found to be unnecessary. A satisfactory piston could also be made of wood or of alternating washers of metal and leather. The valves came from two ten-cent store perfume atomizers; and the exhaust outlet was taken from the opposite end of one of the bulbs. The ingenuity of the individual worker will suggest ways of making other types. An article on a model steam engine in a previous issue (P.S.M., May '35, p. 72) may be of some assistance.

The mount or upright support was made from scrap ½ by 1-in. stock, but that is really heavier than necessary. It can be built up of angle brass, or a piece of hardwood might be used. Bushings reduce the wear, although there is very little.

The shape of the base is optional. A circular piece turned out to try a new lathe was used in the case illustrated. The radio switch is convenient, but not essential.

The motor shown was taken from a small fan. A piece of rubber tubing connects the pump and motor shafts and acts as a universal joint.—B. G. S.

Ornamental Arbors *and* Garden Gates

Sketched by HI SIBLEY

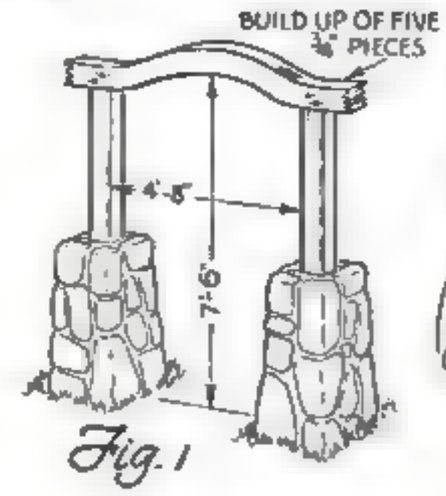
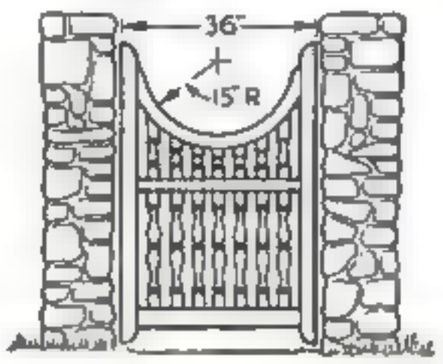


Fig. 1



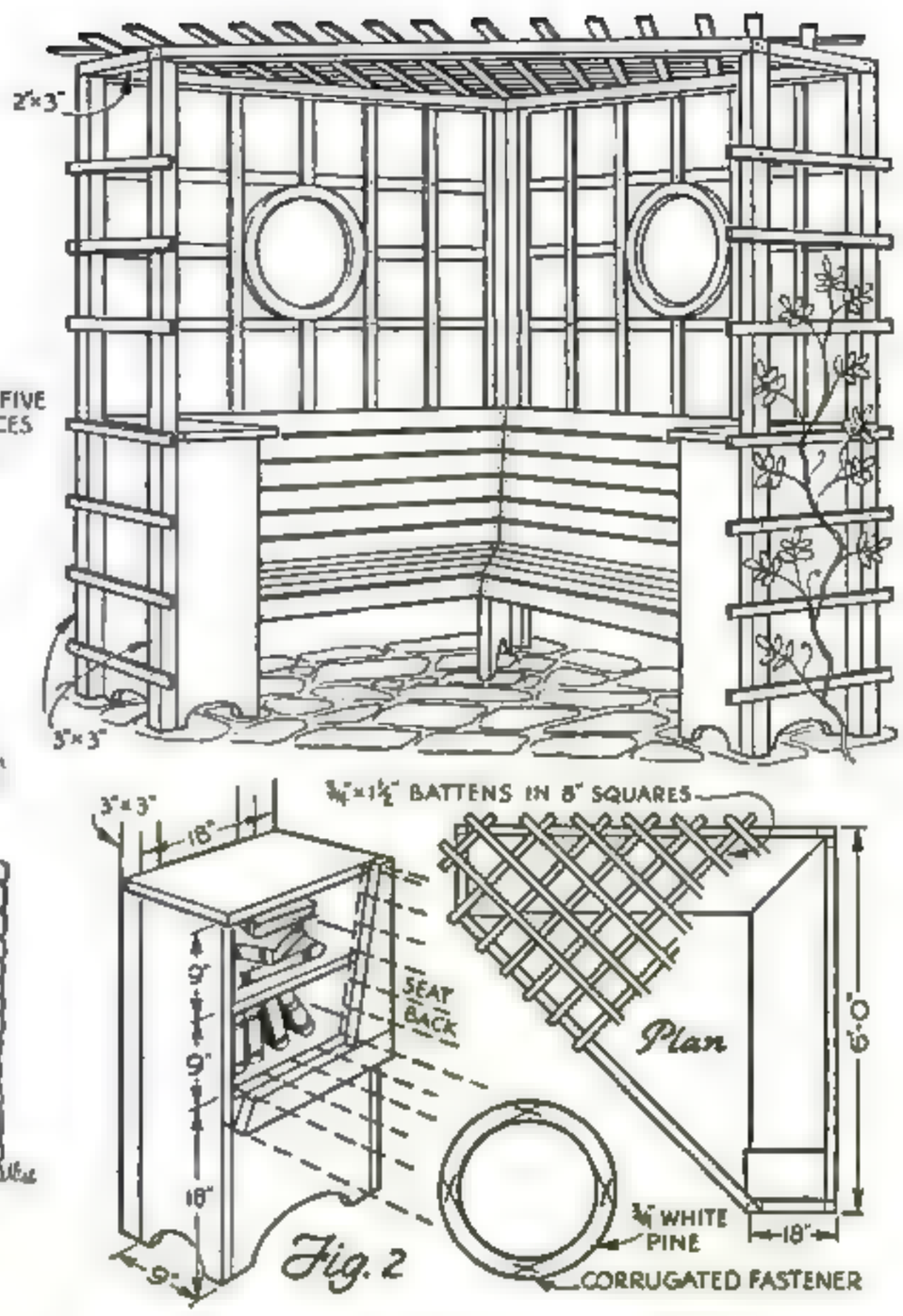


Fig. 2

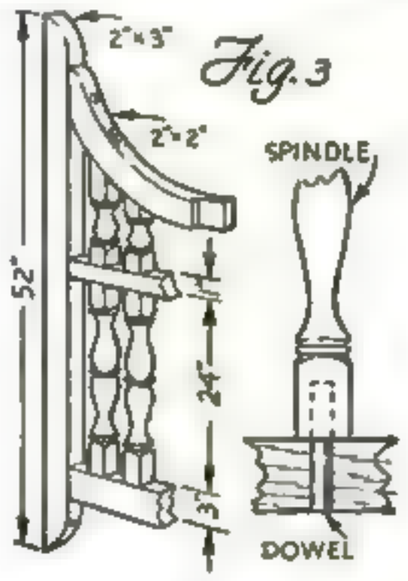


Fig. 3

FROM these drawings you can choose the type of arbor or gate best suited to your own garden. Figure 1 and the photograph above show a gateway in Altadena, Calif. Figure 2 is a corner arbor with utility cabinets for books or craftwork supplies. Add doors to the cabinets if anything is to be left out in them. A good opportunity for lathe work and band-sawing is given by the gate in Fig. 3.

An arbor to be built over a garden walk is shown in Fig. 4; a shelter with shingle roof in Fig. 5; and a rustic arbor made from well-seasoned tree branches or sapling logs in Fig. 6. The bark may be left on the logs used for the latter if it is a variety that clings after becoming dry.

A decorative gate for a driveway is suggested in Fig. 7. Note how the heavy wrought-iron strap hinges also serve to reënforce the corners. The substantial gate in Fig. 8 is effective in an arched opening. It should preferably be built up of ¾-in. oak and allowed to weather naturally.

Figure 9 is a flower-basket seat of pine. The battens may be soaked overnight so they will bend more easily.

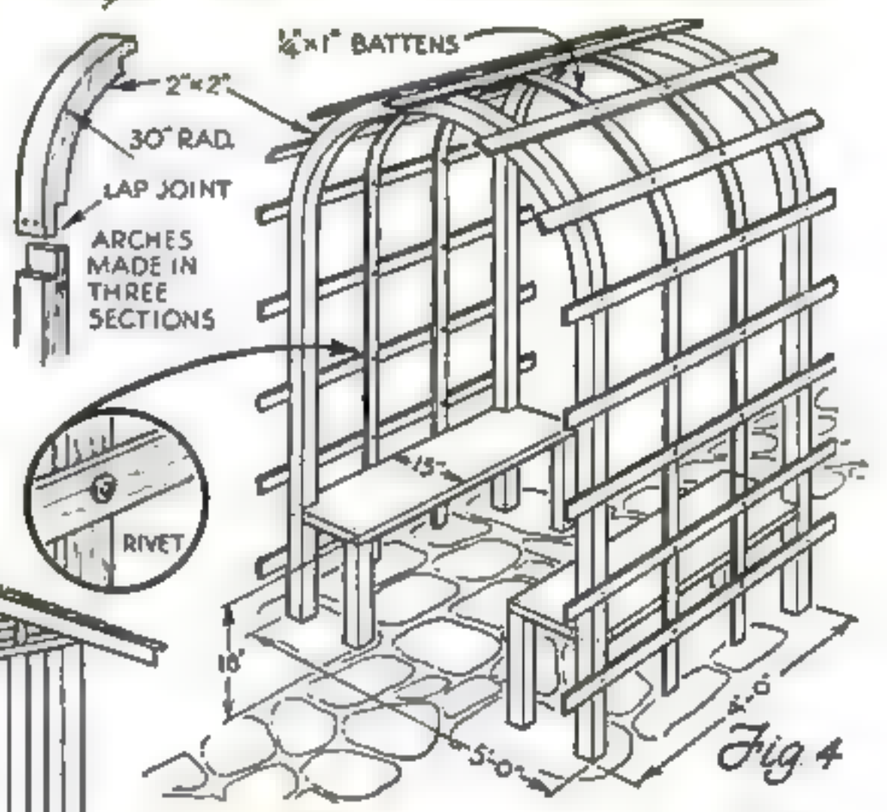


Fig. 4

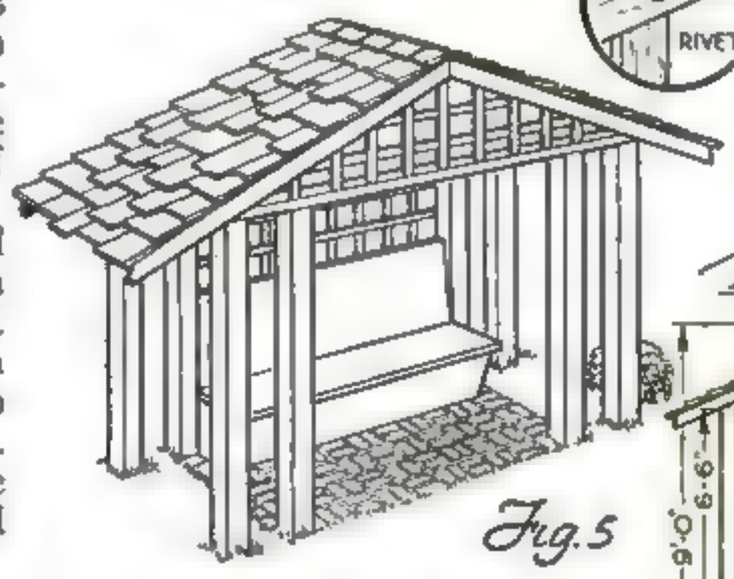


Fig. 5

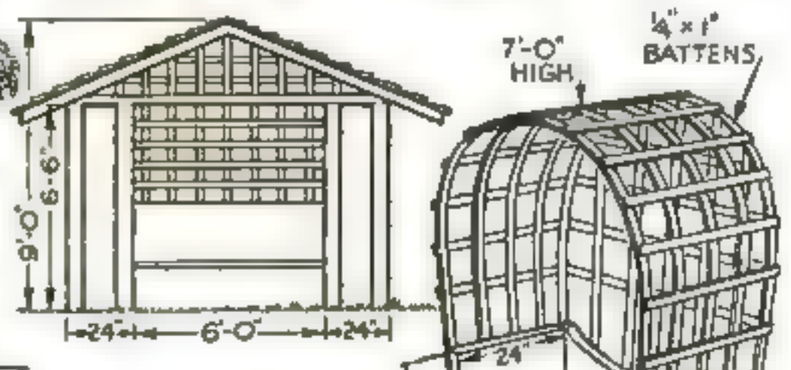


Fig. 9

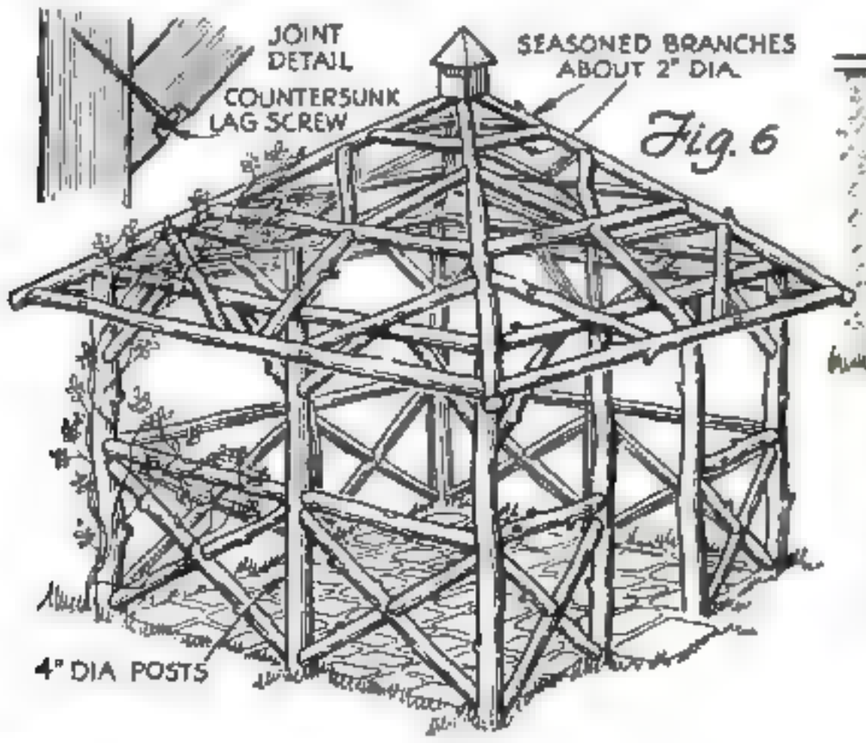


Fig. 6

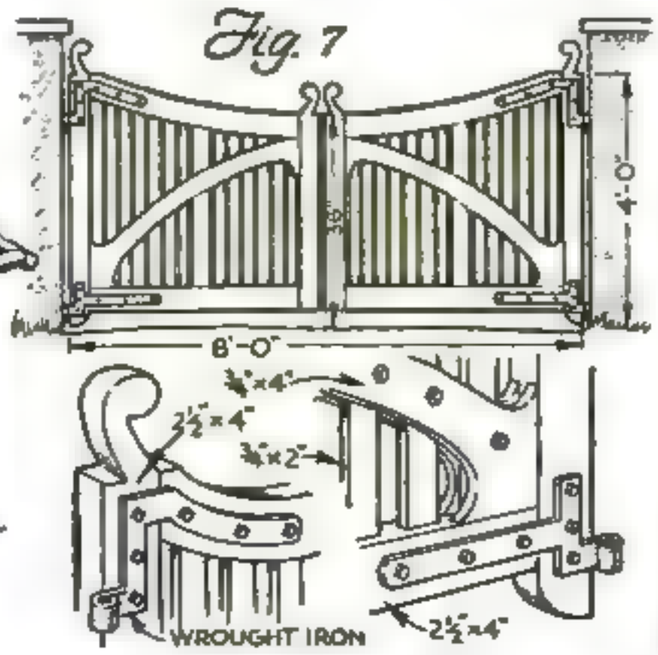


Fig. 7

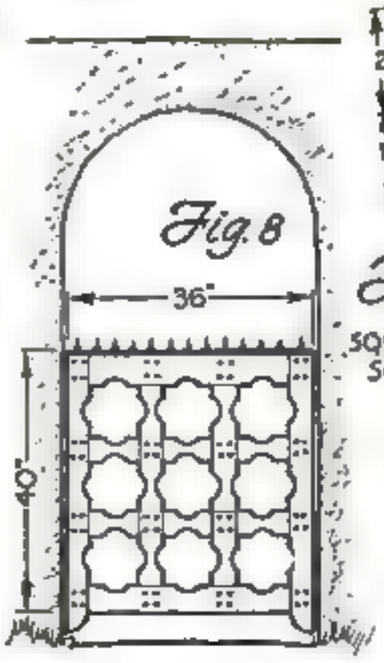
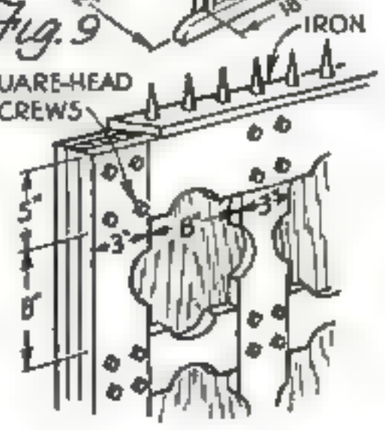


Fig. 8



Beautiful Heirloom Chests

. . . AND HOW TO BUILD THEM

CHESTS were universally used in the old days to store clothing, bedding, and household gear of many kinds. They were often greatly prized and so stanchly built that they could be handed down from generation to generation.

Dower chests were frequently found among the gifts to a bride. There were, indeed, few rooms in the house that did not contain at least one chest. The finest chest was generally placed in the hallway, if there was one in the house. Even today, a beautiful chest such as the paneled one illustrated below will add a note of distinction to the well-appointed hallway.

Paneled chest designed and built by Mr. Gottshall to illustrate advantages of this construction

Few projects appeal more to the amateur woodworker than chests because they are useful, decorative, and not too difficult to construct. Plans for three widely different types are given in the accompanying drawings.

A NATIONAL HOMEWORKSHOP GUILD FEATURE

Paneled Cedar Chest. Because of the knotty structure of aromatic red cedar, it is often difficult to select boards having a good surface, suitable for the wide sides of a chest. If the type of construction shown is used, the stock may be cut up into comparatively small and narrow pieces, thus making it easier to select the best parts of the boards for the important parts.

The proportions have been planned to make the chest an ideal one to be placed at the foot of a bed, at the head of a stairway, or in some other small space where it will serve a useful purpose without taking up too much room. The panels have been designed and spaced to make them unusually attractive.

To build the chest, first cut the legs and bevel the inside corners, either by hand or on the jointer, as shown in one of the photographs on page 97. Next lay out and cut the mortises on the legs. The legs are then grooved on the circular saw, using a ⅜-in. dado head. Since the grooves do not go the entire length of the legs, care must be taken to start them at the upper mortise and end them at the lower mortise. Some consider it safer to do the grooving before cutting the mortises, if the dado head is used.

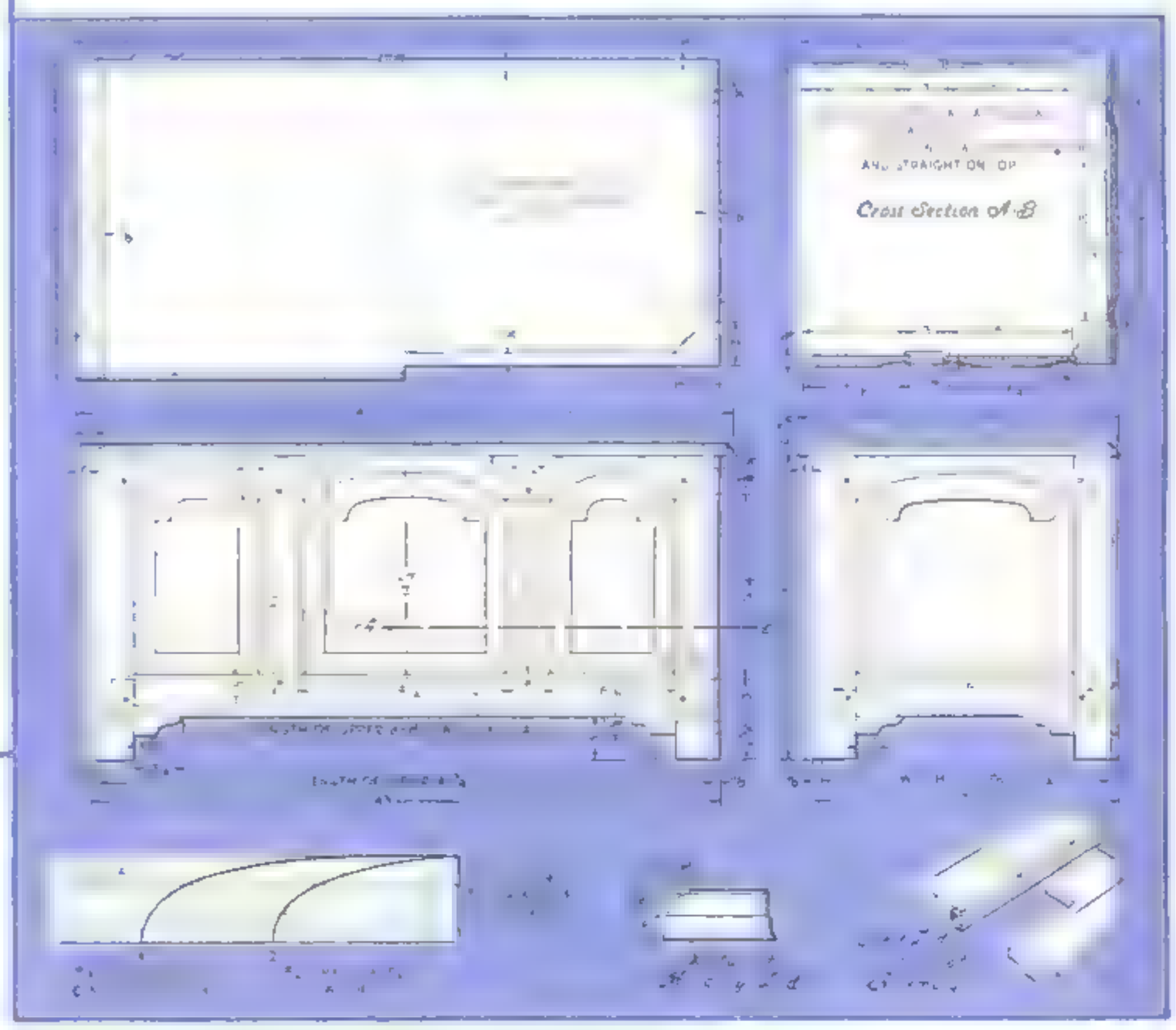
Next cut the rails and stiles. The tenons on these are cut on the dado saw, as shown in another photograph. Do not cut the arches on the upper rails or the brackets on the lower rails until all the tenons and grooves have been cut. The upper rails are first grooved on the dado saw, then the arches are cut, after which the grooves may be cut in the arched parts, either by using the spindle shaper or the mortising attachments on the drill press. Also cut the rabbet for the floor on the lower edges of the bottom rails before cutting the brackets. These brackets, as well as the arches on the upper rails, may be cut on the band or the jig saw. The upper rail at the back of the chest need not be arched. Mortise the rails, then make a trial assembly of the frame.

The panels should now be scraped and the tongues cut on the straight sides. The tongues, which are fitted to the grooved rails and stiles, may be cut with the circular saw or a dado head. The 1/16-in. raised part of the panel may also be started by cutting a kerf along each of its straight edges. Unless a suitable cutter is available

PANELED CEDAR CHEST

No. of Pieces	T.	W.	L.	For
1	⅞	22	45	Top
2	⅞	2	22	Top cleats
4	3	3	21	Legs
1	¾	19¾	41¾	Floor
2	⅞	3	40	Upper rails
2	⅞	3	18	Upper rails
2	⅞	4 ¼	40	Lower rails
2	⅞	4¼	18	Lower rails
4	⅞	3	15	Stiles
2	¾	15¾	14 ¼	Panels
2	¾	9¼	14¼	Panels
1	¼	14¾	14¼	Panels
2	⅜	9 ¼	12¾	Panels
1	⅜	14¾	12¾	Panels

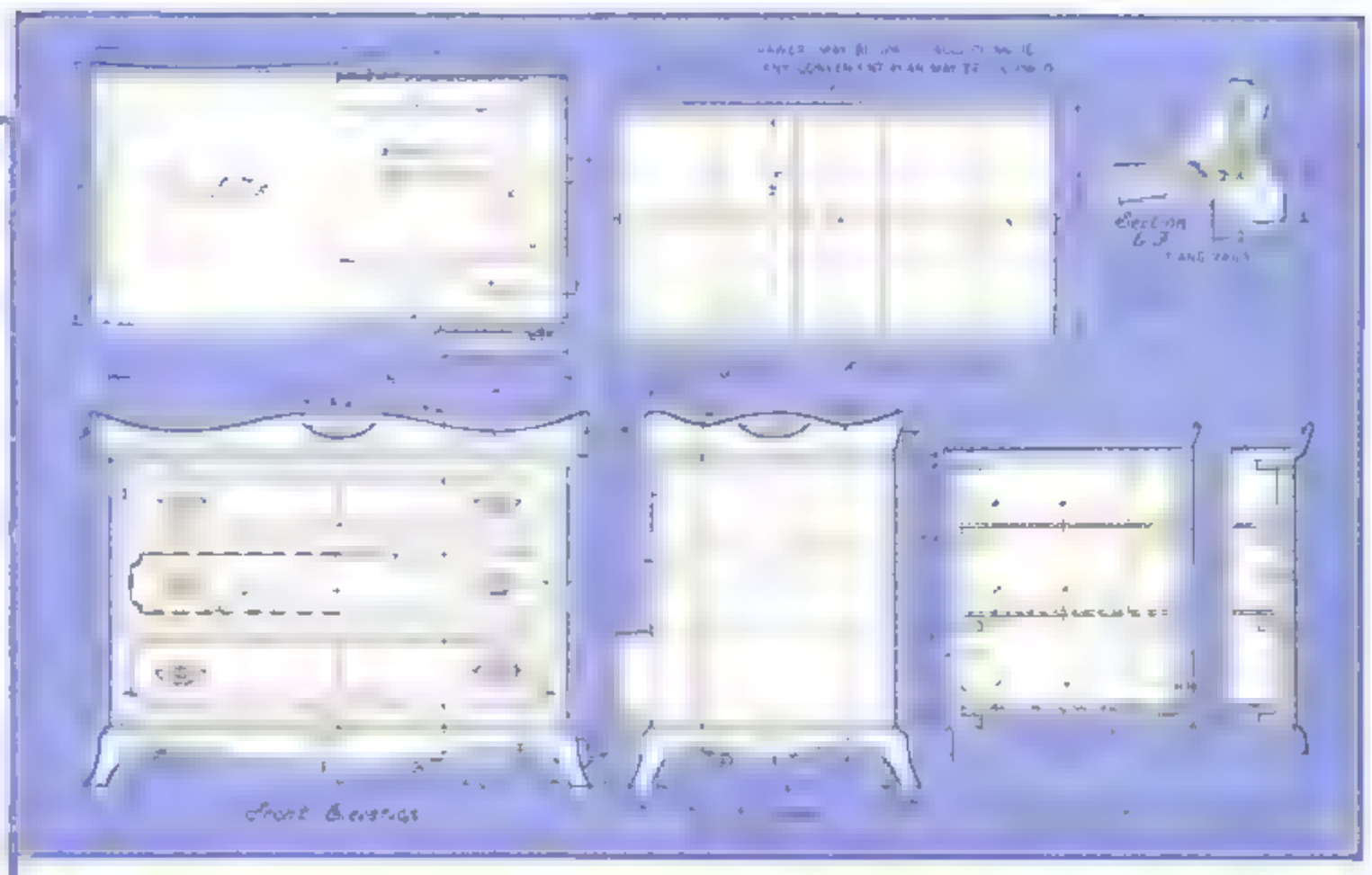
NOTE: All dimensions are given in inches and are finished sizes



Top, front, and end views; cross-section plan view showing how the panels are tongued to fit grooves in the legs and stiles; patterns for the arches; and details of the lid-and-cleat assembly and type of molding cut on the glued-up lid

Two of the designs, one paneled and the other plain, are made of aromatic red cedar . . . The third is a graceful little walnut or mahogany chest of drawers for holding shoes and hosiery

By Franklin H. Gottshall



Working drawings for the shoe-and-hosiery chest. The design is adapted from the style of Hepplewhite, with gracefully curved base and gallery. Mahogany or walnut should be used

HOSIERY CHEST

No. of Pieces	T.	W.	L.	For
2				Ends
1				Back
1				Bottom
2				Top
4				Rails
2				Rails in base
2				Rails in base
1		5		½ Drawer fronts
1				Drawer fronts
1				Drawer fronts
4				Front rails in frames
4				Back rails
2				End rails
2		5	15	Drawer slides
2			15	Drawer slides
2				Drawer slides
1				Drawer backs
1				Drawer backs
1				Drawer backs
3	¾	15⅛	28	Drawer bottoms
4	5/16	4⅞	14 ⅛	Partitions
4	5/16	4⅛	14 ⅛	Partitions
4	5/16	3⅝	14 ⅛	Partitions
1	⅛	17½	29¼	Cabinet back

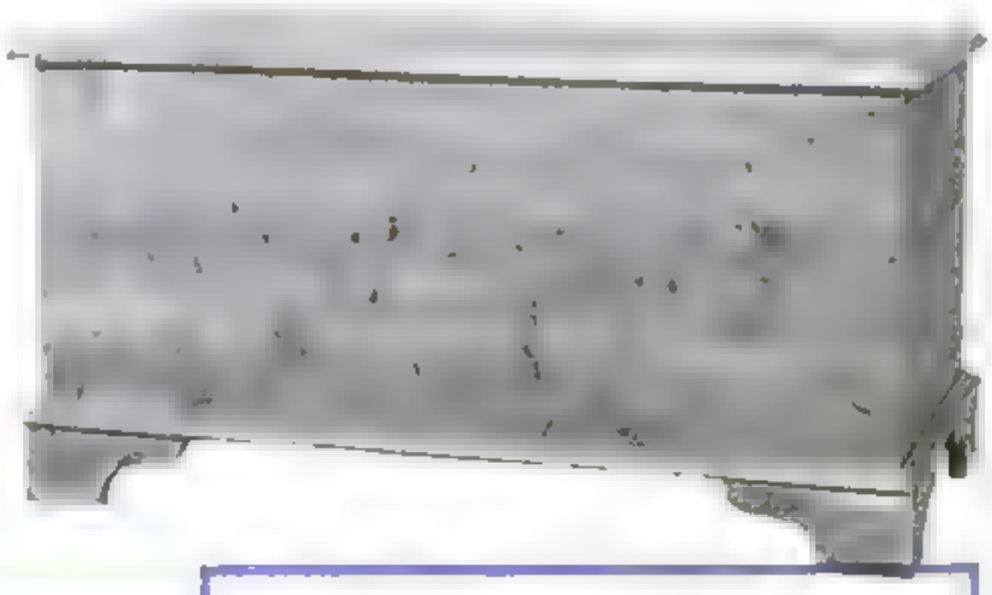
NOTE: See drawing for corner bocks for base. All dimensions are given in inches and are finished sizes

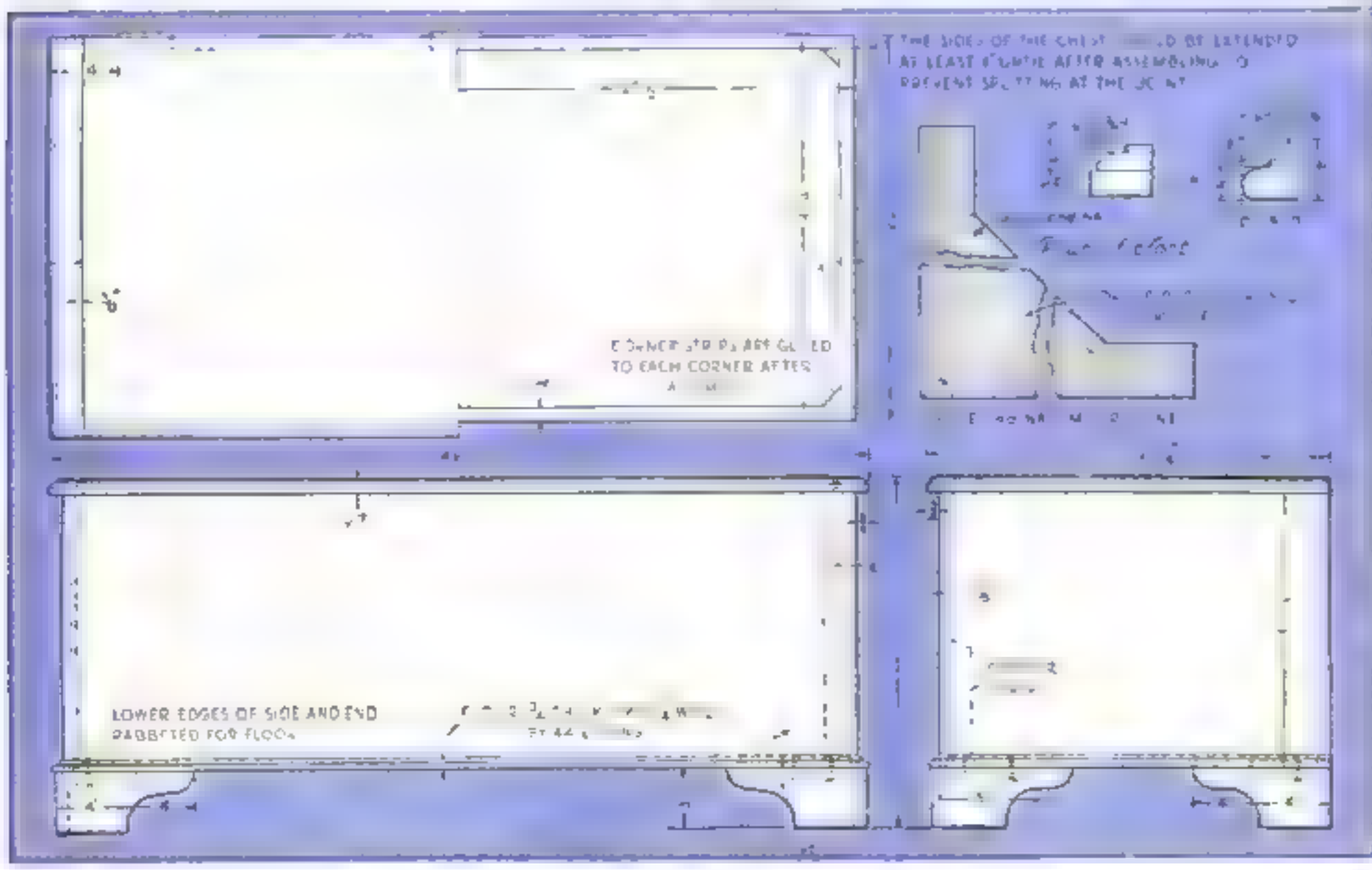
for the drill press or shaper, most of the remainder of the panel raising must be done with chisels by hand. Some of this work may be accomplished by cutting a series of steps on the straight sides with the circular saw. The steps are later smoothed out with a chisel to form the bevel. The arched part of the panel must be cut entirely with hand tools.

When the panels have been fitted, the sides may be glued up. Each mortise and tenon should be pinned with pegs of hardwood. Next glue up the floor, scrape it, and nail it to the rabbet from underneath. Glue up the top. A detail shows the lid and cleat assembly. This is the best construction for a lid of this type. After the lid is assembled, the edges may be molded on the shaper or drill press.

Shoe-and-Hosiery Chest. This is really a miniature chest of drawers for holding a woman's shoes and hosiery. It should be built of walnut or mahogany. The design has been adapted from the style of Hepplewhite. The drawers are tastefully inlaid with a narrow band. The long graceful curves at the top and on the base add a note of elegance and charm, which makes it particularly appropriate for the purpose for which it has been designed and built.

Each drawer is divided into compartments, as shown in the drawer plan. The spacing may be planned otherwise than as shown, if so desired. Each drawer is supported on a frame, the details of which are given in the *(Continued on page 97)*





COLONIAL CHEST

No. of Pieces	T.	W.	L.	For
2		15	15	Sides
2		15	21	Ends
1				Back
2				Lid cleats
8			8	Feet
1			44 ¼	Chest Floor

See drawing for corner blocks for feet and corner strips for inside.

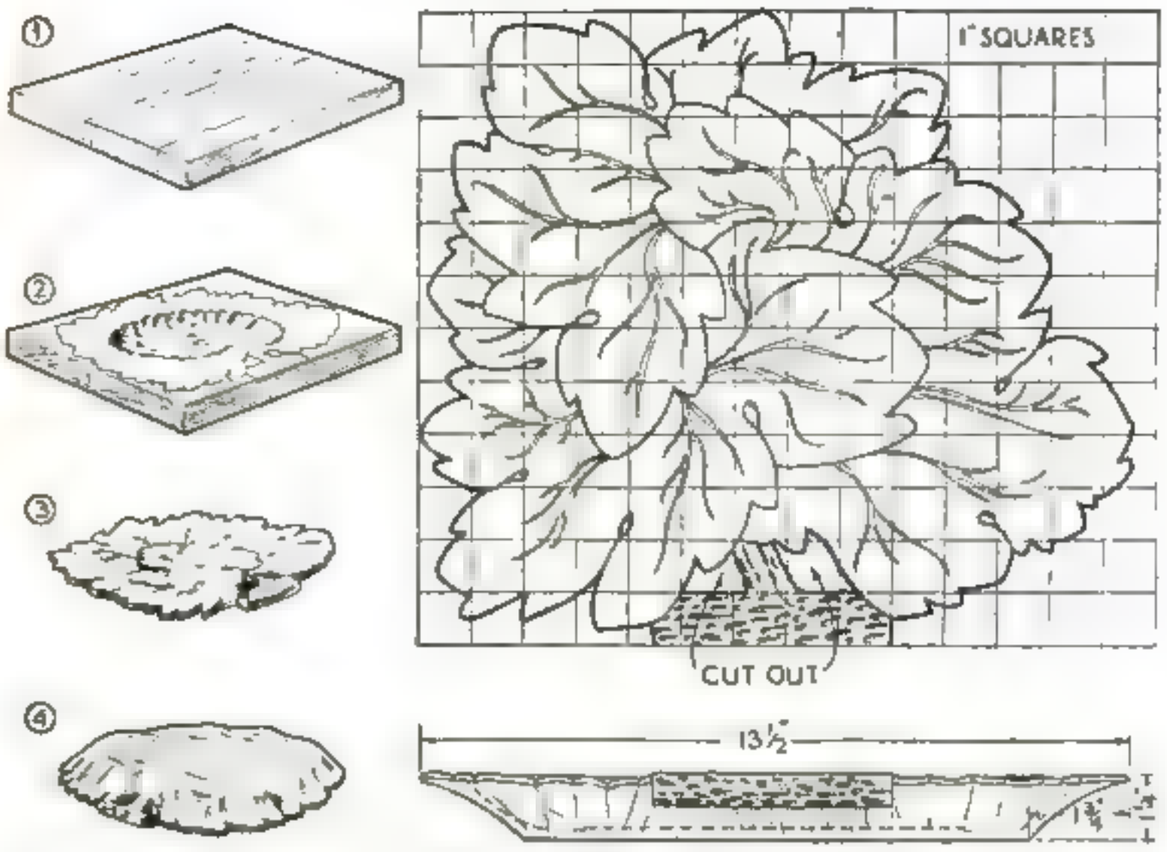
Molding around base approximately 12 ft.

NOTE All dimensions are given in inches and are finished sizes. It is necessary to add 2 in. to the length of the sides to protect joint when being glued

The easiest of all cedar chests to construct is the simple colonial design. Its beauty lies chiefly in the rich color and the knotty grain pattern of the cedar itself

WOODEN FRUIT DISH CARVED TO REPRESENT LEAVES

The dish is carved from a close-grained, light-colored hardwood



How to lay out the pattern of three interlaced leaves; an edge view showing depth to which dish is hollowed; and four steps in making the project

REMINISCENT of the art of the ancient wood-carving guildsmen, this fruit dish imparts an air of richness to the dining-room table or buffet. The design is a triad of large leaves carved from one piece of wood.

The dish may be made entirely by hand with carving chisels, or a flexible shaft with routing cutters and other home workshop machines may be used for much of the work, if available. The stock may be birch or any other close-grained wood that can be had in a size 12 by 13½ by 1¼ in.

Lay off the top in 1-in. squares and copy the outline of the dish from the accompanying drawing with the grain running the long way. Use a machine wood bit having a very short spur, if possible, to rough out the deepest part of the dish. Follow closely the course of the dotted line shown in the edge view. Remember to allow for the depth of the bit spur and when in doubt bore shallow holes in preference to going the limit.

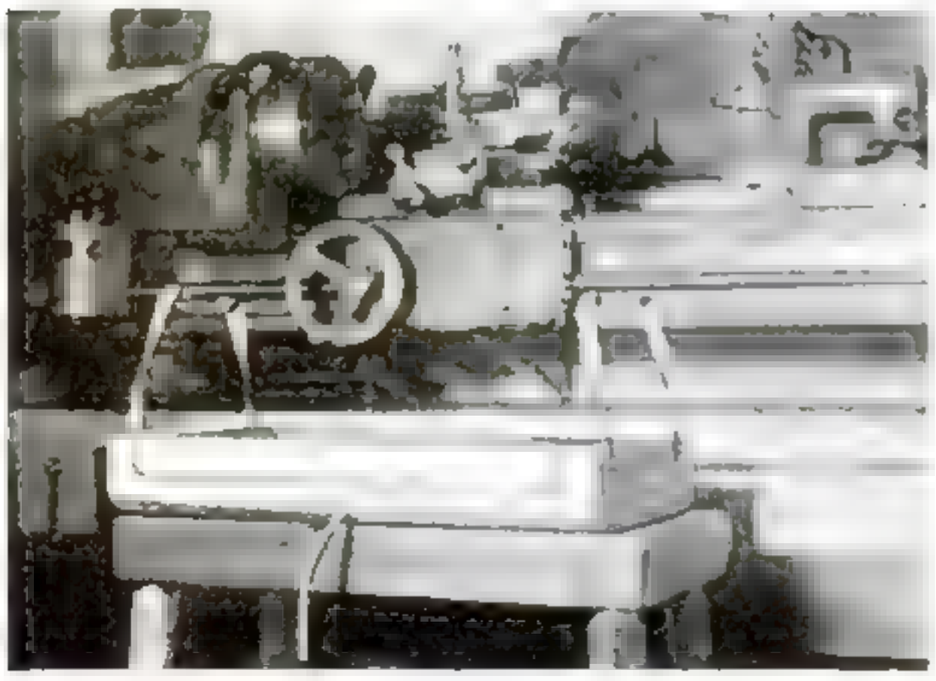
With a gouge rough out the remainder of the interior. Allow ½ in. for the thickness of the leaves where they overlap in the center. The average thickness of the dish other than this area is 5/16 in. Direct-reading or lock-joint transfer calipers are a great help in testing the thickness of the wood. It is better to be cautious rather than risk spoiling the stock by cutting in too far.

Now comes the sawing. Follow the general outline with the jig saw and then saw out the detail of the leaf lobes. Drill holes for the saw and remove the pieces marked "cut out." Turn the dish bottom up and use a gouge to slope the edges to the form indicated in the drawing. A veining tool gives the bark appearance to the twig. With light, smooth cuts bring the inside of the dish to the design shown, leaving the edges of the twining leaf lobes standing 3/16 in. higher than the adjacent area toward the outside. Make the veins in graceful swings, about 1/16 in. deep, using what is commonly known as the reverse or ogee curve.

Start removing the gouge marks with a medium grit sandpaper and finish with a finer grade.

Leave uniform gouge marks on the sloping sides of the underpart. Paste furniture wax is rubbed into surface.—D. W. PRINCE

LATHE CHIP PAN CUT FROM LARGE CAN



Chip pan and lathe under which it is used. The four hooks are twisted and bent to catch over the V-ways of the lathe

ALTHOUGH it should not take more than half an hour to make, the lathe chip pan illustrated is neat in appearance and serves its purpose adequately. It is hung from the lathe bed by means of the four hooks shown and has a small drain cock to drain out any cutting oil.

A standard 5-gal. square tin is used. A line is scribed lengthwise around the can 2 in. from the side, and the can is cut to the mark. Be sure to bend over the edges to prevent possible injury to the hands. The hooks are made from 1/16-in. sheet metal and riveted to the tin so they can swivel, thus making the removal of the pan a simple operation.

A piece of copper tubing soldered to the pan serves as a drain tube. Bend it so the end hangs out over the front of the bench. In order to stop chips from clogging it, a piece of fine wire gauze is soldered over the tube opening inside of the pan, and this should be cleaned at intervals.—B. K.

Photo chemicals are quickly mixed with this T-shaped rod

T-ROD FOR STIRRING CHEMICALS

MORE thorough mixing of photographic chemicals may be assured if the ordinary glass stirring rod is improved by making it T-shaped as illustrated at the left. Cut about 2 in. off the end of the rod and heat the end sufficiently to enable the small piece to be welded on crosswise.

To use the rod, rub it between the palms of the hands so that it revolves rapidly. The agitation of the liquid thus obtained will be found to dissolve the chemicals in a fraction of the time previously required.—I. C. L.

TRICKS IN MAKING

Comfortable Camp Beds

By MAURICE H. DECKER

CAMPING AND WOODCRAFT EDITOR OF "OUTDOOR LIFE"

Fastening a blanket at the bottom with sticks to make an improvised sleeping bag

WOODSMEN and timber cruisers know lots of tricks for sleeping comfortably with a limited amount of bedding. Up in Wisconsin, Sammy Crow showed me his way of making one blanket do the work of two. You dig out a place in the ground 6 in. deep for your bed, bank the dirt around the edges, and put in any dry litter you can find, such as pine needles, moss, grass, leaves or ferns, as shown in Fig. 1. Then you crawl in and fold your blanket about you. Even if you can't find litter for padding, this bed is warmer than one made on top of the ground. The banked-up edges help hold the warmth of your body.

There's a trick, too, in wrapping yourself up in a single blanket. Lie down on the bed and spread the blanket over you. Now lift both legs without bending your knees and tuck first one side, then the other side of the blanket smoothly under them. Next raise your hips and do the same. Then lift your feet and flip bottom edge of folded blanket underneath. Finally, pull the upper edges one at a time about your shoulders. This makes a sort of blanket roll in which you can turn without being exposed.

Another woodsman's trick is to make the single blanket into a sort of sleeping bag. Fold the bottom edge in thirds and pin together with two sticks and some cord as shown above. This gives two thicknesses of wool over your feet, which usually get cold first, and prevents your toes from sticking out at the bottom.

One blanket will keep you comfortable on very cold nights if you use this stunt, said to have been a favorite with the Blackfoot tribe: Clear away a space for your bed 4 by 7 ft. Build a fire on it, enlarging the fire until the entire space is covered. Keep the blaze burning for at least one hour—two hours are better. Then rake away the embers and coals. Hunt an overhanging bank or log under which is dry, unfrozen dirt. To prevent the blanket from catching fire, spread an inch layer of this dirt over the ashes you couldn't remove. Make up your bed on the heated ground. It will stay warm for hours and keep you snug and cozy.

Can you make a real browse bed? That's another trick that stretches the protective powers of a single blanket. First you must locate the right timber. Balsam fir is best, hemlock comes second, then cedar, and finally spruce. Pine is poorest of all, being hard and stiff.

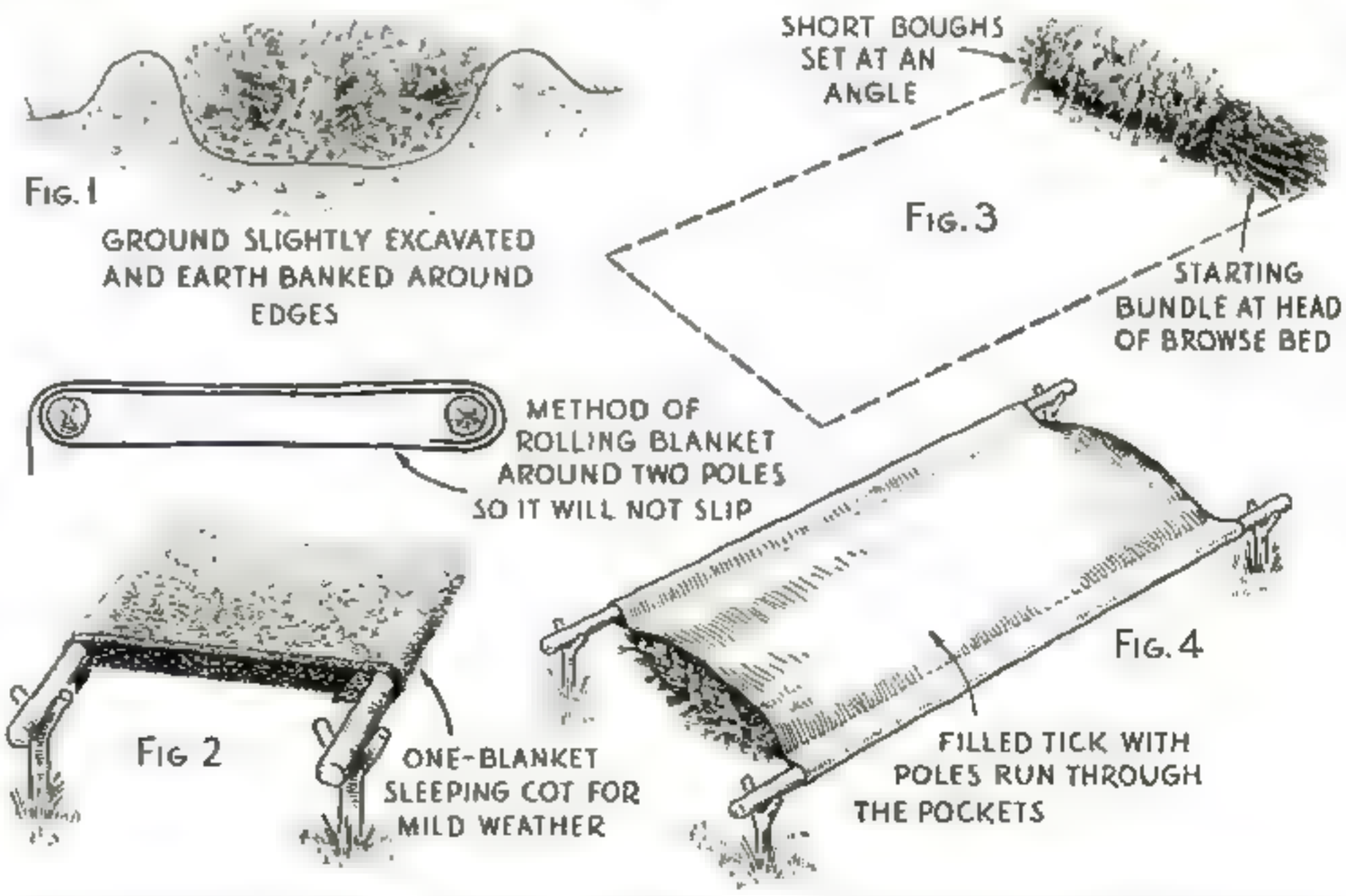
The secret of making a good browse bed is to keep it level, not high in the middle and low at the ends. Gather a number of the longer, coarser branches. Alternating their tops and butts, tie them into a bundle some 7 in. thick and as long as the width of your bed. Lay this bundle down at the head to start building against. Gather a quantity of evergreen boughs about 1 ft. long. Lean these in rows against the bundle at a 60-deg. angle as shown in Fig. 3. Stick their butts lightly into the ground if possible. Lap each fan-shaped branch in the row halfway across its neighbor and build enough rows to gain the desired length of bed—usually 6½ ft. Single browse beds are made about 28 in. wide, double beds from 42 to 48 in.

Browse beds last longer if you inclose them in a frame of logs. Butt the ends of the logs together and hold in place with short stakes. Even if you camp in country without coniferous timber, you can thatch a comfortable bed from the small springy branches of willow, alder, or birch. While not as comfortable as fir, such material is better than the hard ground.

The Red River trapper's bunk is another good trick to know. Just make a bed-size frame of logs on the ground and fill it full of grass, leaves, or wild hay. Add fresh litter as the old becomes packed or broken.

The Michigan cruiser's tick is both comfortable and easy to carry in your pack sack. Make a bag of stout drill 38 in. wide and 76 in. long, and sew a 5-in. pocket along each edge. Carry it rolled up and empty. At night, fill the bag with dry litter, slip a pole in each pocket, and support the ends on stakes as shown in Fig. 4.

One blanket and two poles will form a good warm-weather sleeping cot. You don't have to lace or tie the blanket edges. Simply wrap them as shown in Fig. 2 and your weight will hold them taut without slipping. Unless you are very tall, put the blanket crossways on the poles and gain more width. This cot provides three thicknesses underneath, which are welcome even on warm nights. Support the ends of poles with stakes.



Sammy Crow's ground bed, a warm-weather sleeping cot, a browse bed, and a cruiser's bedtick

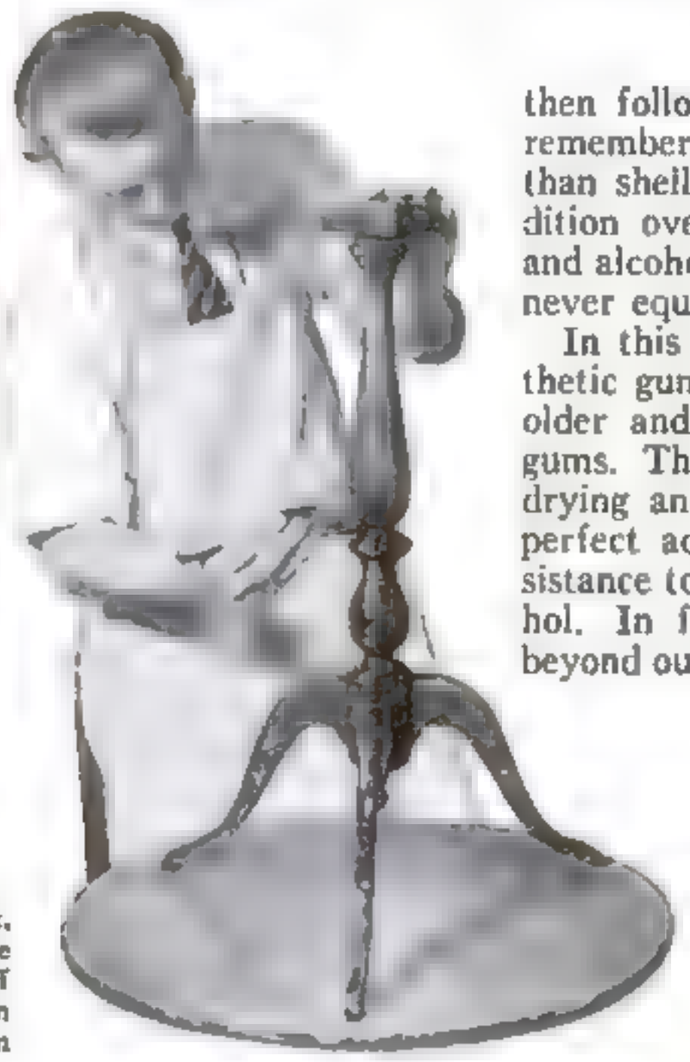
THE FOUNDATION OF GOOD

Furniture Finishing

. . . SEALERS AND FILLERS

Applying the sealer coat. The brush is held at an angle, and strokes are made from center towards each end. Note swivel stand

By RALPH G. WARING



On turned work, stroke around the column. Tip off the long portion gently up and down

MANY a heated argument has been started at home workshop club meetings over the question of what kind of sealer coat or undercoater should be used in finishing fine handmade furniture. Should it be shellac or varnish?

Before attempting to settle this question, it is necessary to consider just what is required to obtain a really good finish on furniture or other cabinetwork. In general, three steps are necessary:

1. A staining process.
2. A sealing or undercoating process, which includes the filling of the grain in all but very close-grained woods.
3. A bodying-coat process.

The use of stains was discussed in the preceding article in this series (P.S.M., June '36, p. 64). The second process leads us at once into the field of argumentative discussion of the merits of shellac and varnish.

Shellac is a gum dissolved in a special grade of denatured alcohol, which, when applied to a surface and allowed to dry, hardens by the loss of the solvent (alcohol) alone. This is a purely mechanical process in which the wet film hardens and loses weight.

Varnish is today made of synthetic gums, melted with heat and combined with drying oils such as linseed or tung. Drying agents are added, and the varnish is reduced to a working or brushing consistency with turpentine or a similar type of solvent. When such a material is applied to a surface, it hardens partly by loss of the turpentine, partly by absorption of oxygen from the air, and changes from a liquid to a solid film by a chemical process. The final product is neither physically nor chemically similar to the material in the can and has actually gained in weight during the change from liquid to solid.

It is therefore evident that the two systems are fundamentally opposed to each other. While expediency frequently demands their combination, yet no real affinity exists between a coat of varnish and a coat of shellac when the latter is used as an undercoater. If you use shellac at all, use it throughout the entire schedule from start to finish. Remember, however, that it will have only fair resistance to wear, very little resistance to water, and none at all to alcohol (liquors or perfumes).

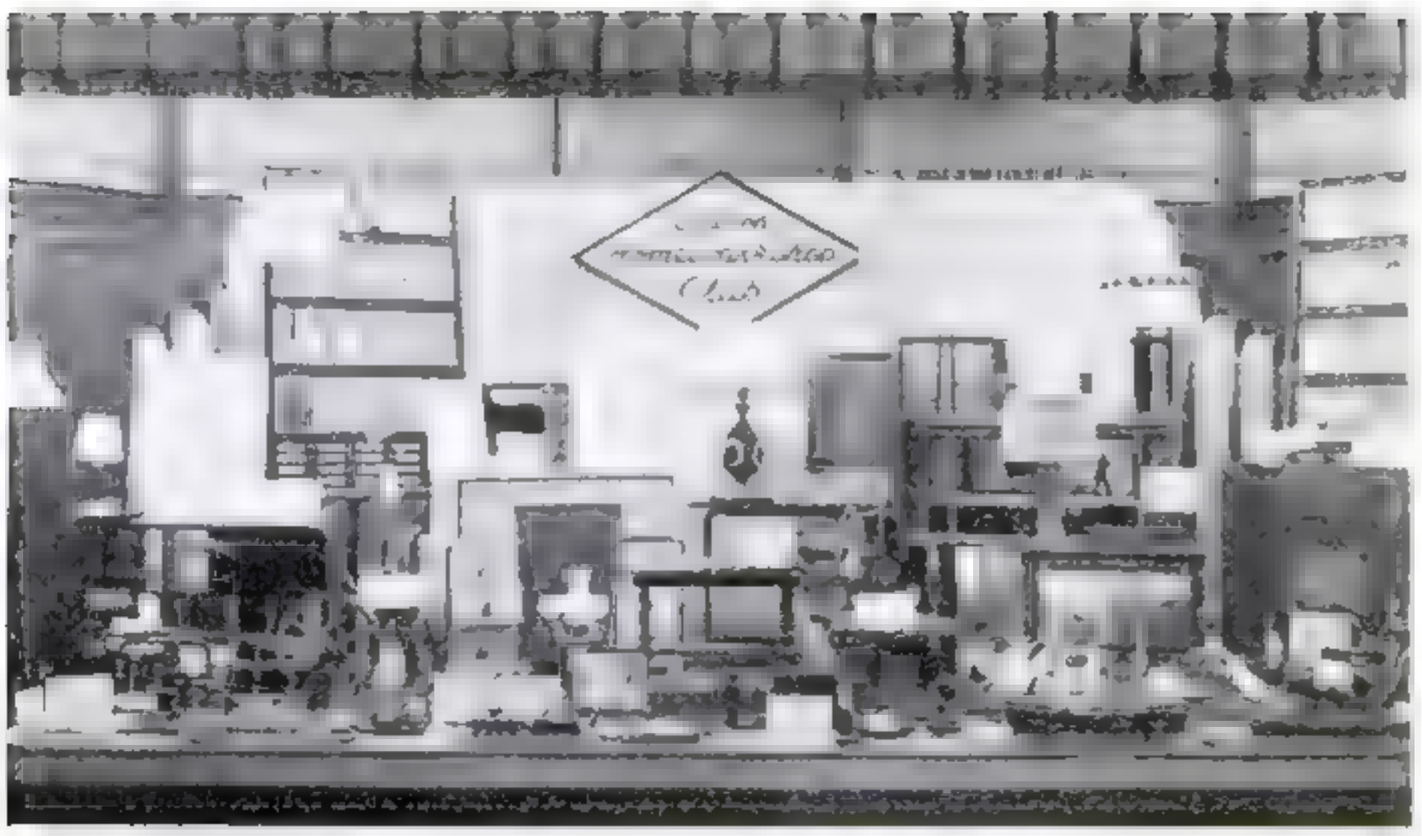
If varnish is to be used, as it should be, then follow a complete varnish schedule, remembering that it will do much more than shellac can mechanically and in addition overcomes wear and resists water and alcohols in a manner that shellacs can never equal.

In this day of modern chemistry, synthetic gums and resins have replaced the older and less desirable forms of fossil gums. The new varnish products are fast drying and clean sanding, and they give perfect adhesion between coats, high resistance to wear, water, sunlight, and alcohol. In fact, they are so fine as to be beyond our dreams of but a few years past.

After staining a piece of furniture, we are confronted with the necessity of protecting the color against subsequent operations. If no sealer is used, the filler may easily discolor a clear and delicate stain coat, because of the absorption of oil and fine pigment around the pore areas. To overcome this, shellac may be used in a shellac schedule or varnish in a varnish schedule. In either case the sealer coat must be greatly reduced in body.

For shellac sealer, use what is called standard "four- (Continued on page 90)

The filler must be brushed in quickly but thoroughly. The young man at right is cleaning moldings with a picking stick and cloth



Window exhibition of the Edison Homeworkshop Club which drew large crowds in Chicago

Twenty-seven Clubs Get Charters from NATIONAL HOMEWORKSHOP GUILD

TWENTY-SEVEN clubs of home craftsmen in the United States and Canada have been granted charters by the National Homeworkshop Guild since the recent announcement that it would no longer be necessary to ask clubs to pay national dues (see P.S.M., June '36, p. 63). Guild headquarters in New York have also been deluged with requests for information about starting home workshop clubs, and this indicates that many more groups are in the process of organization. The fact that the various services of the Guild are now offered free to all local home workshop clubs of five or more members has set the whole movement marching rapidly forward.

The clubs that have just received their charters are as follows: Ozark Homeworkshop Club, Rolla, Mo.; East Side Sawdust Eaters Homecraft Club, Detroit, Mich.; Berkshire Homeworkshop Club, North Adams, Mass.; St. James Workshop Club and Cartier Homeworkshop Club, Montreal, Canada: Sterling Hobby Guild and Greenwich Village Homecraft Club, New York City; Lowell (Mass.) Homeworkshop Club; Fall River (Mass.) Homecraft Club; Edmundston (N. B., Canada) Hobbyists; Glendale (Calif.) Homeworkshop Club; Southeast Homeworkshop Club, Huntington Park, Calif.; Lackawana Homeworkshop Club, Penticton, B. C., Canada; Wilmington (Del.) Homecraft Club; Brockton (Mass.) Homecraft Club; Czecho-Slovak Crafts Club, New York City; Brookhaven Homeworkshop Club, Chester, Pa.; Lamesa (Tex.) Homeworkshop Club; Boonsboro (Md.) Woodworking Guild; Minneapolis (Minn.) Homeworkshop Club; Columbia Homeworkshop Club, Paterson, N. J.; Fowler (Kans.) Homeworkshop Club; Lakeside Homeworkshop Club, Muskegon, Mich.; Santa Monica (Calif.) Homeworkshop Club; Chase's Mills Homeworkshop Club, East Machias, Me.; also clubs at Hornell, N. Y., and San Jose, Calif., the names of which are to be chosen later.

Official Magazine POPULAR SCIENCE MONTHLY

Types of toys made in quantity by the Shenango Valley Club, Sharon, Pa. *At left:* A group of members of the Fairmont Club of Fairmont, W. Va., with toys made for distribution to needy

Right: Officers of the Hobbyists' Club, Edmundston, N. B., Canada, with shield bearing club emblem

Edison Homeworkshop Club, Chicago, Ill. In the club's first contest there were fifty-two entries. After the judging and regular exhibition, the projects were placed in the largest window of the Edison Company building where they attracted much attention for five days. Prizes were awarded as follows: first prize, which was a high-grade jig saw, and the Popular Science Monthly Craftwork Award of a sterling silver medal, to L. F. Holstein for a coffee table with inlaid ship design; second prize, a band saw, to L. H. Juhnke for a modern end table; third prize, a power grindstone, to G. W. Anthony, Jr., for a modern cosmetic table; fourth prize, an automatic oilstone, to E. M. Dittmer for a card table with veneered top; fifth prize, a set of wood scrapers, to D. G. Arnett for a sanding machine; sixth prize, an oilstone, to H. O. Sandberg for a pair of boudoir lamps; seventh prize, an oilstone, to Earl Getchell for an electric question-and-answer board. Honorable mention was awarded to G. C. Bailey, a lamp-post figurine; H. L. Pedley, card of wood buttons; E. E. Cornell, punching and shearing machine; C. F. Wetzel, modern electric clock. While the judging was being done a sound motion picture about lumbering was shown by Jack Parker to the members and visitors in another meeting room.

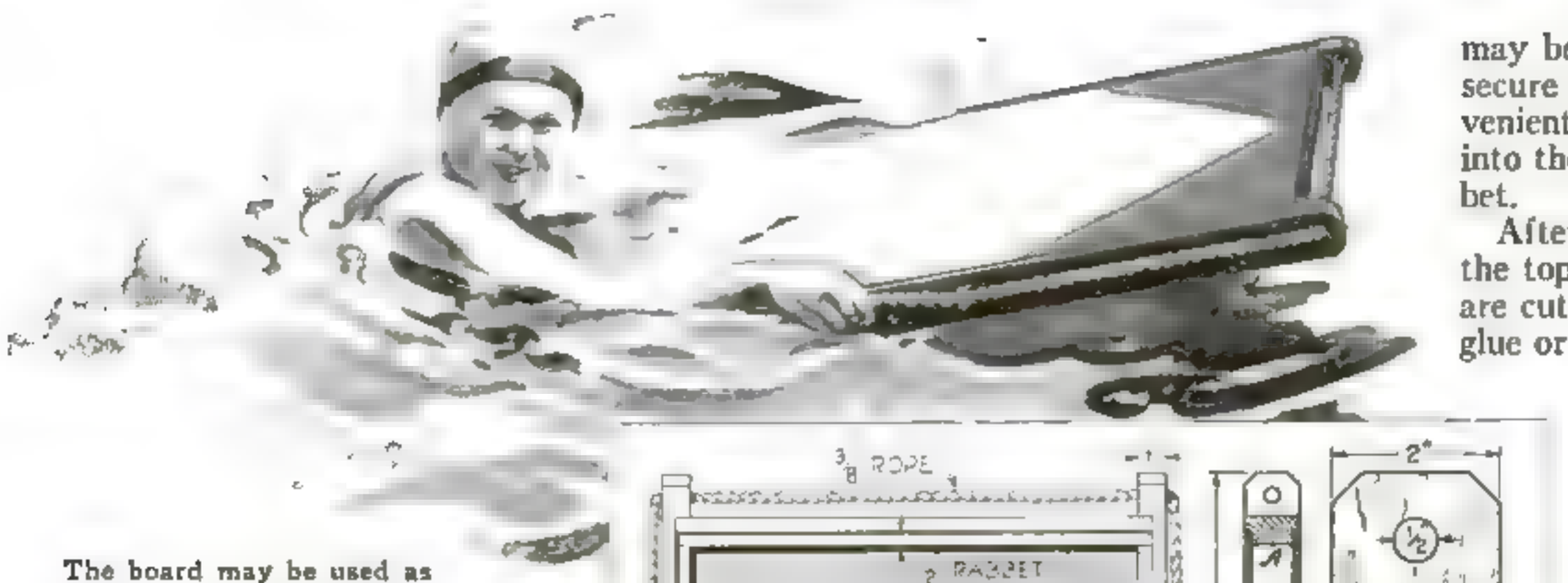
Lexington (Ky.) Homecrafters. A representative of the Department of Industrial Arts, Berea College, presented a program recently. . . . A letter was received from the Frontier Nursing Association thanking the club for the annual donation of over 300 Christmas toys. . . . The annual exhibition of members' projects was held at the showroom of a local hardware company, and a cup was awarded the best display.

Brunswick (Me.) Homeworkshop Club. Two instructive programs were presented recently. William E. Wing, principal of Deering High School, gave a demonstration of decorative wood carving, and Clem Sutton presented pointers on painting. The first evening was arranged by Kenneth Boyer, and the second by Gerald Russell.

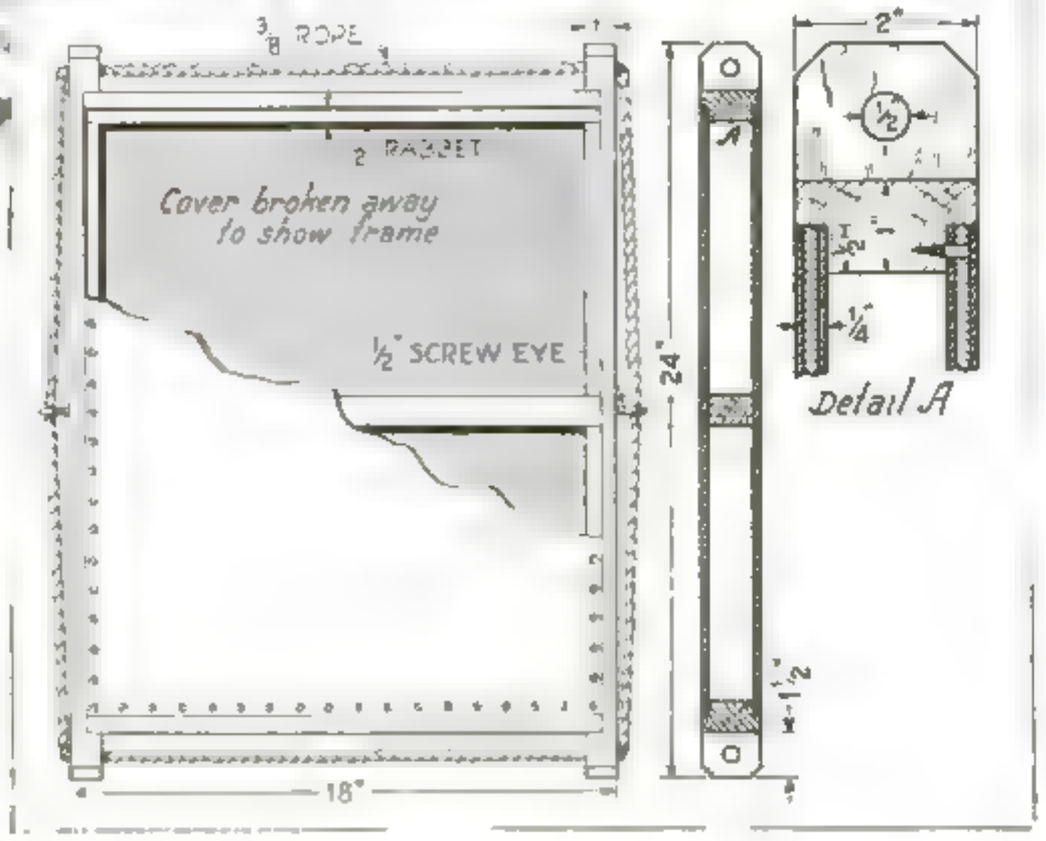
Bison Homeworkshop Guild, Buffalo, N. Y. The cup for the best club exhibit at the recent Hobby Show has been presented to this club for the second year in succession.

LaGrange (Ill.) Homeworkshop Club. In order to relieve hosts of the expense of renting chairs for meetings, the members met at the home *(Continued on page 100)*

Hollow Swimming Board Helps Beginners



The board may be used as a "base" for swimmers in deep water or to give confidence to beginners. It is of especial help in learning to kick properly



TO THE average boy or girl, half the summer's fun, whether at the beach, the lake, or just "the old swimmin' hole," is associated with the water. One accessory that will add to the fun and be of practical use to the novice is a swimming board, like that illustrated. A learner may use the board for support while practising the thrash kick. Another use is as a temporary rest or "base" for a group swimming in deep water, or to give greater confidence to a beginner by demonstrating his buoyancy in the water.

The board is 18 in. wide, 24 in. long, and 2 in. thick, less projections, and displaces approximately ⅓ cu. ft. water. Neglecting for the moment the weight of materials, the board thus has a buoyancy of approximately 30 lb., as required for life preservers of the approved type.

The frame is of 1 by 2-in white pine, spruce, or cedar, rabbetted on the top and bottom inner edges to receive a covering of ¼-in. 3-ply fir of the water-resisting type—that is, glued with waterproof glue. The side rails project 1½ in. beyond the ends in order to pass a rope through ½-in. holes. Galvanized or brass screw eyes may be used midway of the side rails to secure the rope in the form of several convenient loops. The end rails are mortised into the side rails to the depth of the rabbet.

After the frame is assembled and painted, the top and bottom 3-ply covering boards are cut to fit the rabbet and set in marine glue or white lead with 1-in. No. 6 screws, spaced 2 or 2½ in. apart. Before assembly, the inner sides and edges of the plywood should be primed with spar varnish or white lead to render them more waterproof.

The completed board may be finished with natural spar varnish, or with white lead primer and white or colored enamel or lacquer. The edges and rails are painted a contrasting color.

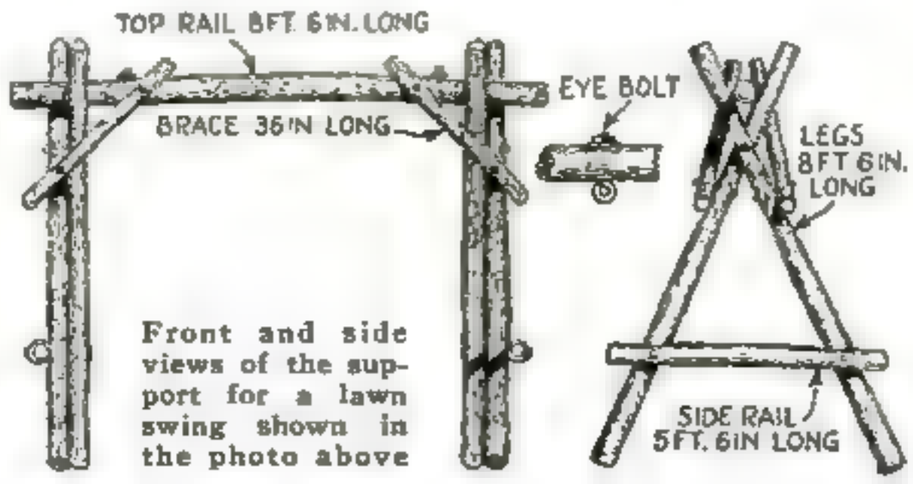
After the paint is fully dried, a length of ⅜-in. Manila rope is loosely threaded through the holes in the side rail projections, and the free ends are spliced with three passes.

The board illustrated has been in use four years, and has assisted in teaching the writer's three children to swim in 30 ft. of water by the age of from 4 to 6 years. It has also been used to teach two 16-year-old nonswimmers in the same deep water in two weeks' time, and has assisted many others.—B. G. HATCH.

CONSTRUCTING RUSTIC SWING SUPPORT

SMALL logs or poles may be used in many ways for constructing rustic fixtures and furniture for the lawn and garden. The poles may be obtained in almost any woodland, along streams or rivers, and, if permission is asked, usually can be had for the cutting.

The support illustrated was made for an ordinary porch swing. Five logs 8 ft. 6 in. long are needed for the legs and top rail, and four pieces 36 in. in length are required for the braces. The side rails are 5 ft. 6 in. long. The braces and side rails are smaller in diameter and are cut from the tops of the legs and top rail. Poles about 4 in. across at the bottom are the proper size to cut for this purpose and should be as nearly alike in size as possible. Bolts ½ in. in diameter are used at the top where the legs cross, and ¼-in. bolts serve for attaching the braces and side rails. This support can be taken down without difficulty in a short time and stored inside for the winter season.—HAROLD JACKSON.



Front and side views of the support for a lawn swing shown in the photo above

FLOWER BASKETS HANG FROM GARAGE WALL

GARAGE walls are often painfully blank in appearance, but this can often be remedied by putting up three or four hanging flower baskets, made of fine mesh chicken wire as illustrated above. The wire can be tacked to a backboard of suitable size and shape, or the basket may be made entirely of wire and attached to the wall by means of a cleat at the top. In the latter case, see that the basket is held well away from the wall so that the paint will not become streaked below.

Line each basket with a layer of moss and fill the cup thus formed with rich soil.

Lighting the Miniature Stage

FLORENCE FETHERSTON DRAKE
Tells How to Create Atmosphere for Marionette Dramas

Oriental scene with footlights, two lower floods, and one upper. The producer is Roger Hayward, Pasadena, Calif. *At right:* A light with muffin-tin reflector

LIGHT—vibrant, pulsating, atmospheric—is the heart of any stage picture. Much has been said about the intricacy of stage lighting, but it is not really difficult. The fundamentals may be learned in an evening and, so far as the miniature or marionette stage is concerned, the necessary equipment costs little and is easily assembled.

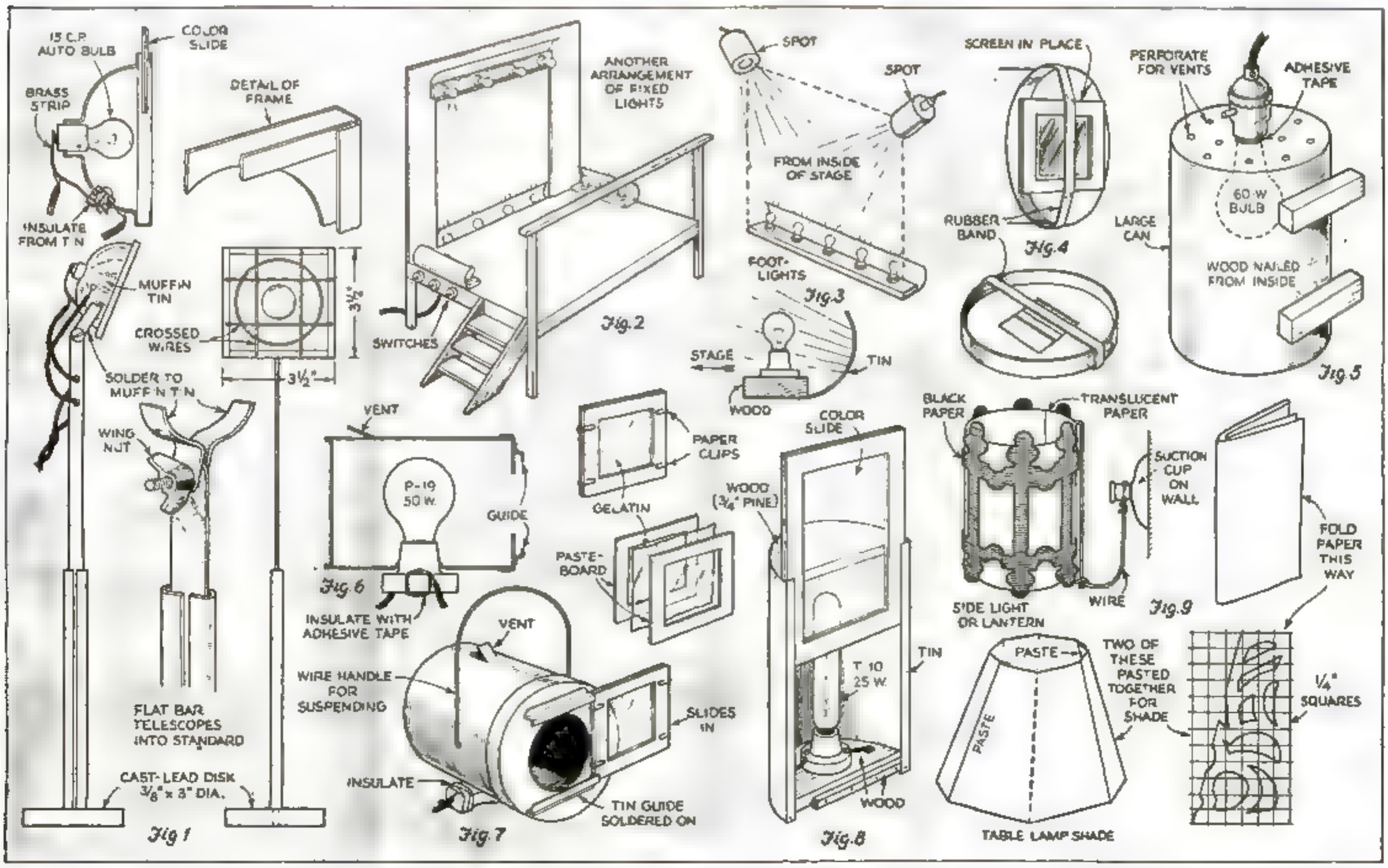
Before considering the practical side, it is necessary to ask just what does light do in the theater. First, it illuminates stage and actors. Second, it indicates, through suggestion, effects of nature, hour, season, and weather. Third, it helps to paint the stage picture through heightened color values as well as by manipulation of masses of light and shadow. Fourth, it lends relief to the actors and to the plastic elements of the scene. Fifth, it helps act the play by symbolizing its meanings and reënforcing its psychology. One light may combine several or all of these functions.

The lighting of a play is a psychological and temperamental matter as far as the audience is concerned. Its effects are as subtle as music. Until recently practically all lighting was direct, the lights being used full blast for comedies and dimmed for tragedies, but stage lighting has become an art and today is one of the most important factors of stage design.

There are two methods of stage lighting, direct and indirect. With the latter there is no glaring illumination, and atmospheric effects can be obtained much more effectively than with the direct system.

If the light is too intense, too brilliant, every illusion of depth is destroyed and under it actors and stage sets appear flat. Depth and solidity are obtained by contrast of light and shadow. Light can obscure any parts of the stage and reveal what it will. If we know how to use it, there is no end to the effects light can achieve.

Light comes from a definite direction, determined outdoors by the position of the sun; in- *(Continued on page 91)*



Sketches of various types of equipment used by Mrs. Drake. It is essential, of course, that all wiring be well insulated to avoid fire hazards

HOW TO ASSEMBLE A

Supersensitive RELAY

FOR USE WITH

Photo-Electric Cells

IN ORDER to have the doors of your garage open when the automobile head lamps throw light on a photo-electric cell, or to have room lights automatically turn on when it becomes dark outside, some means must be used to step up the power from the photocell circuit so that it will close a switch on the 110-volt house current line. The very feeble impulse must be magnified, as it were, so as to perform satisfactorily and instantly whatever task is required of the apparatus.

The need for amplifying the power is especially evident in the case of the new electronic photocells. This is true whether they are of the commercial variety or are constructed at home by the method described in a previous issue (P.S.M., Mar. '36, p. 72). Dry-disk cells of this type convert light directly into an electric current without the aid of outside power sources. Although this current is very small, on the order of milliamperes, the relay to be described is sufficiently sensitive to handle it effectively in making contact across both 10-volt alarm-bell and 110-volt power circuits.

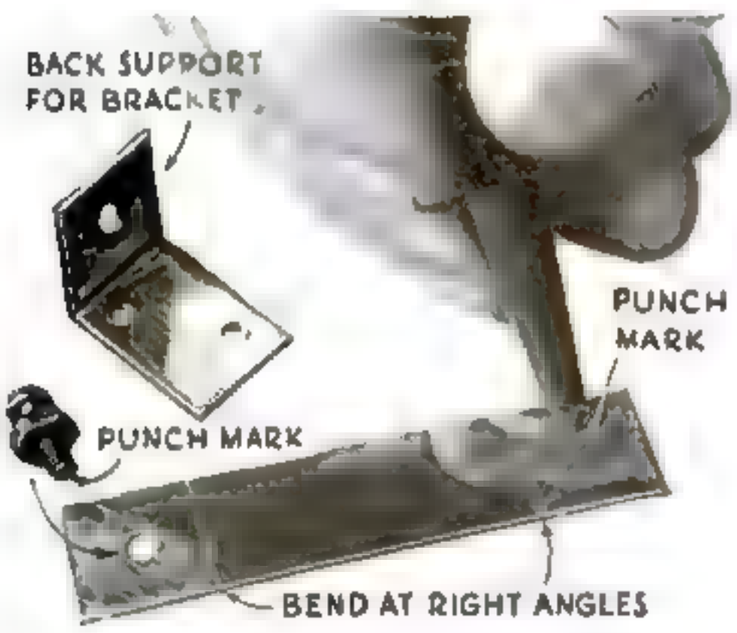
The parts required in the construction of the relay are simple—a doorbell transformer, two porcelain sockets, a bar magnet, and some odd pieces from the junk box. The weak photocell current is fed directly into a small solenoid coil mounted on a vane, which is delicately balanced so as to turn at the slightest effort.

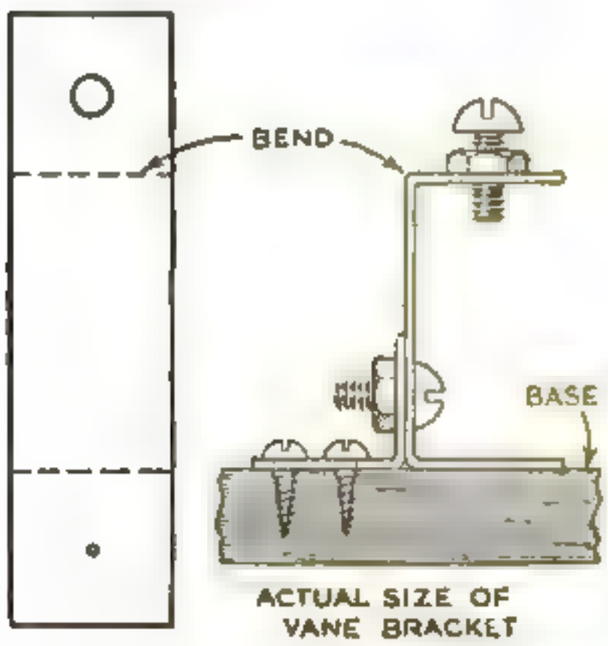
One milliampere of current passing through the moving coil is sufficient to attract it to a permanent magnet, closing the contact across a 10-volt doorbell transformer circuit. This alone is enough for ringing a bell when a beam of light is interrupted. However, the transformer current in turn is made to close a 110-volt house current switch for the operation of small motors (for opening and closing doors or any similar purpose) and electric lights.

An idea as to the sensitivity of the relay can be had by attaching the leads from 200 turns of magnet wire to the binding posts where the photocell is ordinarily connected. Passing a bar magnet back and forth through the coil will produce enough current to actuate the relay and thus turn on a lamp in the 110-volt circuit. This striking demonstration of the efficiency of the relay is illustrated in the photograph at the beginning of the article.

Parts for the bracket that holds the moving coil vane can be made from sheet copper or brass, as shown in a photograph and in one of the drawings. The vane is cut from sheet brass of the thickness of bond writing paper. Two phonograph needles are soldered end to end at the middle (as indicated in the photographs below) for a balanced shaft. The top needle is held in a punch marking made in the end of a small screw passing through a nut soldered to the top of the bracket; the lower needle engages a similar punch mark in the lower part of the bracket. Solder a silver contact point (from an old doorbell or buzzer) to one end of the vane, and fasten the moving coil to the other end, on the opposite side, with celluloid cement.

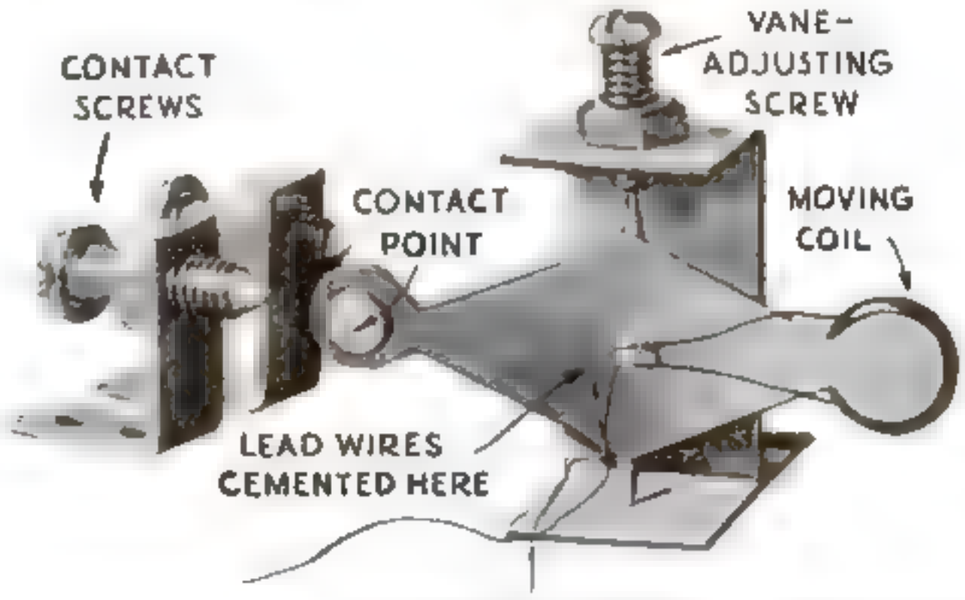
In the view of the completed vane and bracket, note that the coil wires are brought around to the opposite side and held at the middle with a drop of cement. From this position they lead to binding posts on the mounting board, but they also serve as tension springs against which the coil must pull in order to close the contact. These wires must be delicately adjusted to provide a

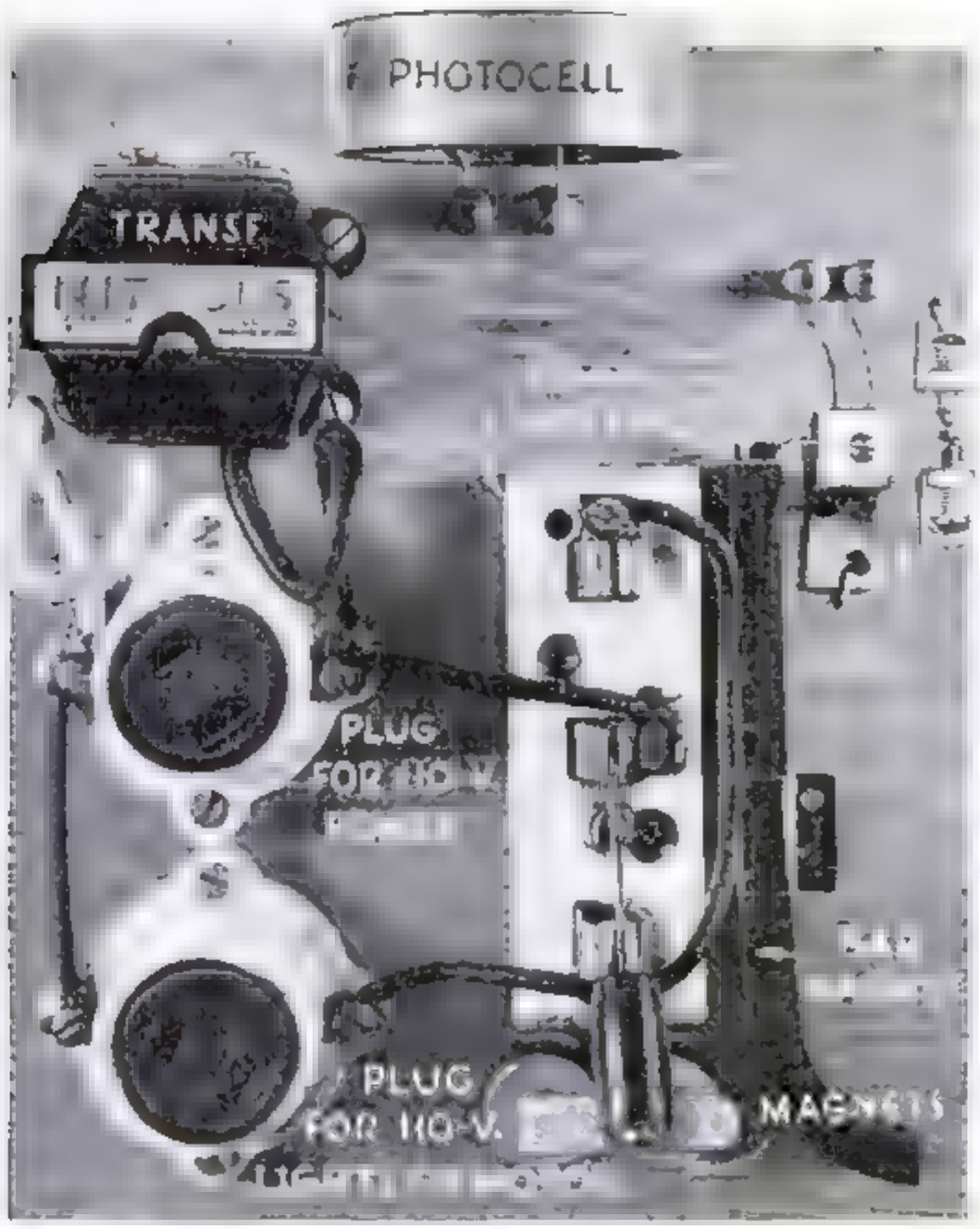




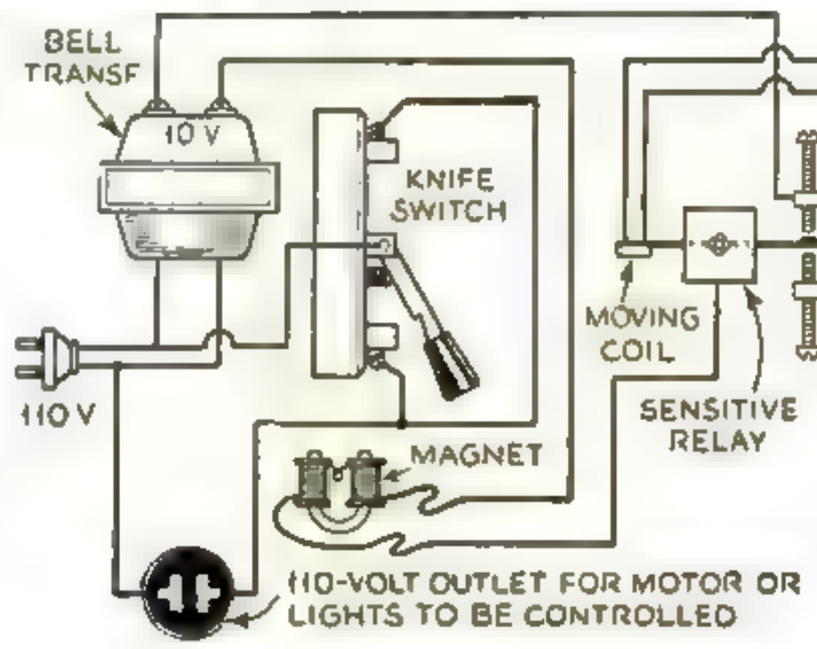
Patterns for vane and bracket, and how the bracket is drilled, indented, bent, and set up. The large photo at top shows an experiment to prove remarkable sensitivity of the relay

Left: Fastening coil to vane with cellulose cement. The shaft is made of two phonograph needles. *Below, at right:* The vane set up in the bracket





Top view of the completed relay unit mounted on a board 7 by 8½ in. The wiring diagram is given at the right. All 110-volt wires are above the board; the remainder, below it



By KENNETH MURRAY

very small resistance against the movement of the vane.

For the moving coil, No. 40 enameled copper wire is used. You can obtain this from the secondary of an old Ford spark coil. It has a resistance of about 1 ohm per foot, therefore the correct length of wire must be wound to provide the right amount of resistance for the type of photocell to be used. A selenium type cell will require considerable resistance to handle the higher voltage used in such a circuit. If you wish to operate the relay from an electronic (dry-disk) type of photocell, a coil of very low resistance must be used. From 3 to 10 ohms resistance is satisfactory.

The author used 5 ft. of wire, giving a resistance of 5 ohms. It was first pulled through a rag soaked in benzine to remove the wax coating (as it had been taken from an old spark coil) and was then carefully wound on the shank of a ¼-in. drill bit. A little shellac will hold the coil in shape until it is cemented to the vane.

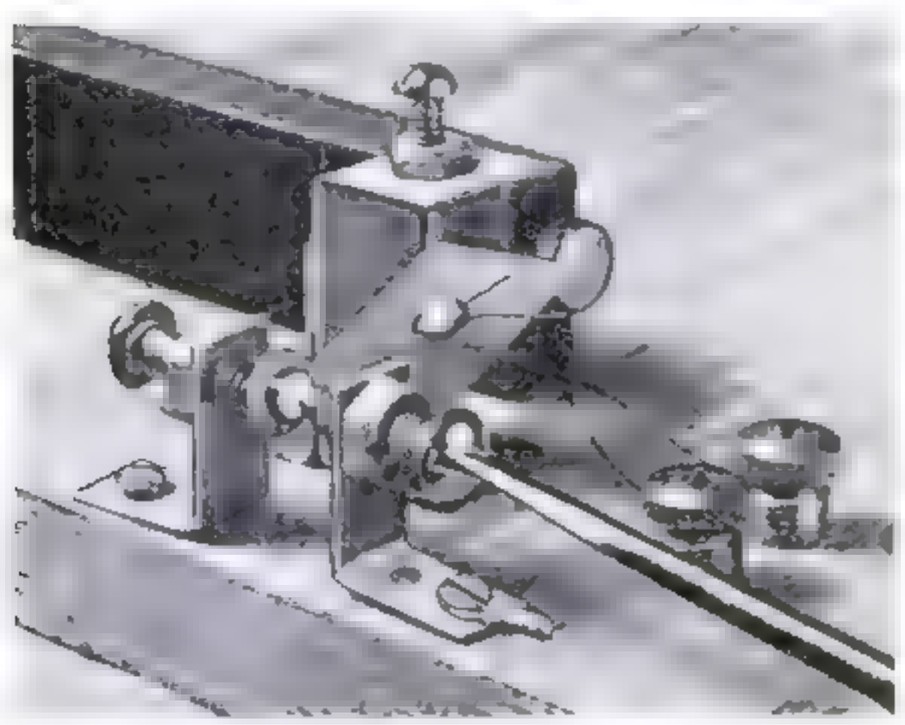
A photograph below shows how the coil is placed next to the end of a permanent bar magnet, with the lead wires connected permanently to binding posts. The contact screws are held in nuts soldered to small pieces of copper bent at right angles. The screw at the back is for adjusting the vane so that the coil is at the correct distance from the magnet, while the front screw has a silver contact point opposite the contact point on the vane. The 10-volt transformer circuit is completed through vane bracket and front contact screw bracket. These all require careful and delicate adjustment to be sensitive to a weak current passing in the moving coil, but once adjusted they need no further attention.

The 110-volt circuit is closed by means of a single knife switch actuated by electromagnets from an old doorbell. These are fed, when the vane contacts close, from a 10-volt bell transformer. Two illustrations suggest how the knife switch may be altered. A weak spring keeps it in the open position until a bar of soft iron (also from a doorbell) attached to the handle is pulled down by the magnets.

As the relay is really a combination of a sensitive and a rugged relay, the two units may be mounted separately if desired. The sensitive relay, however, must be near the photocell if it is to receive all of the current generated by the latter. The view at the top of this page shows both relays mounted as a complete unit, with the photocell at the top, on a board 7 by 8½ in. The parts can be grouped on a much smaller board if there are space limitations. It will be noticed that all 110-volt wiring is above the board, while the remainder is placed underneath. The power line is plugged into the socket next the transformer, while the lights or motor to be operated by the relay are plugged into the other socket.

It will be seen that the magnets controlling the 110-volt switch are placed some distance from the moving coil vane. Being actuated by 10-volt alternating current, both the magnets and knife switch must be adjusted to reduce the hum caused by alternating current, so as to avoid vibration of the moving vane. This is, of course, of no consequence if the relay is mounted as two separate units.

The electronic photocell delivers direct current, therefore care must be taken in connecting it to make sure that light falling on the cell causes the moving coil to be attracted to the magnet. If it is desired to have the relay make contact when a light beam is interrupted, the cell should be connected so that light falling on it causes the coil to be repelled from the magnet so long as the beam is on.



Left: Careful adjustment of the front contact screw is required to make the relay supersensitive. The back screw governs space between coil and magnet

Electromagnets fastened to the baseboard pull down the handle of the knife switch. Note at left how blade of knife switch is filed down to insure a clean make-and-break contact

NEW AND EASY WAY TO Lay Out *an* Accurate SUNDIAL

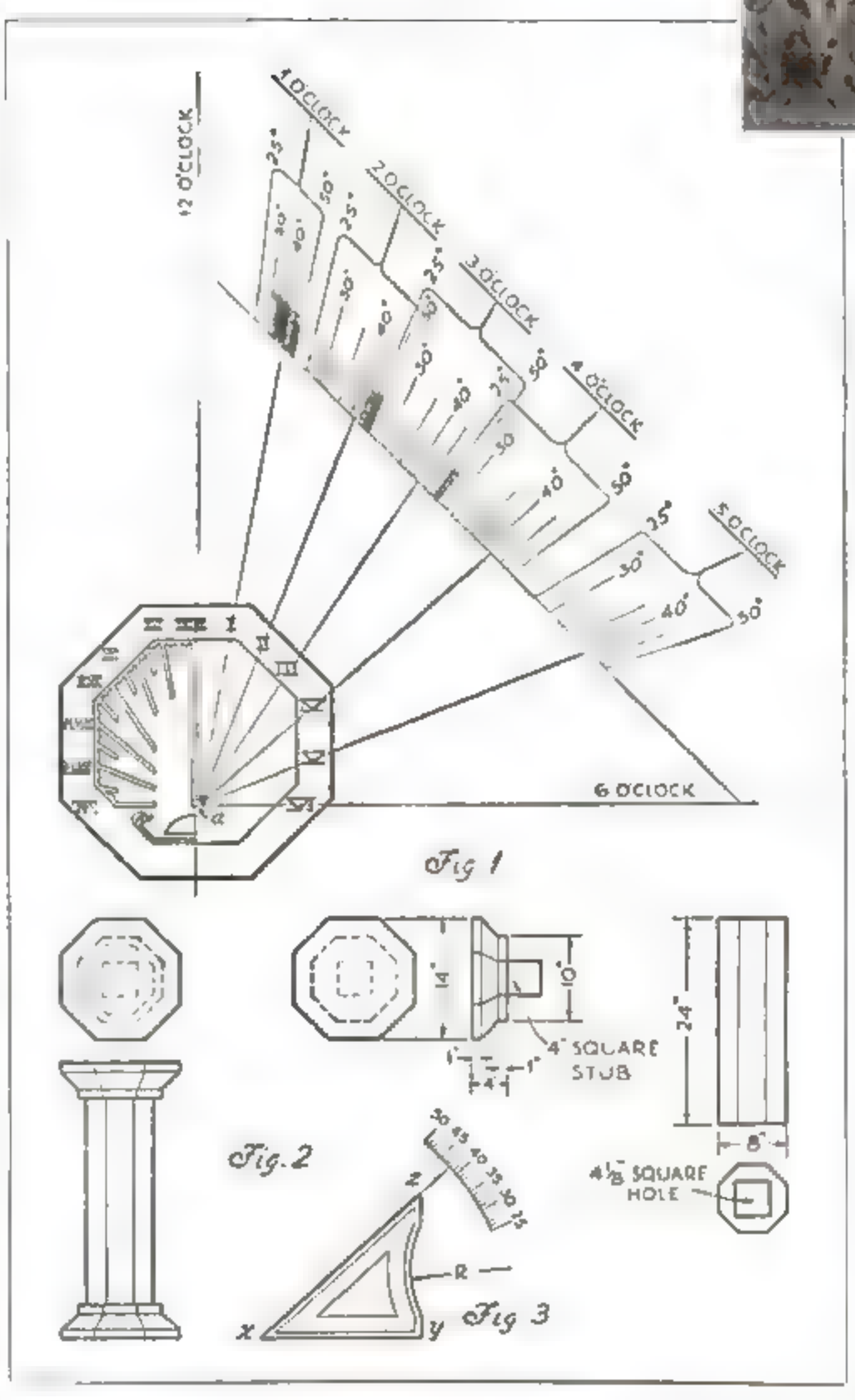
By George B. Harran

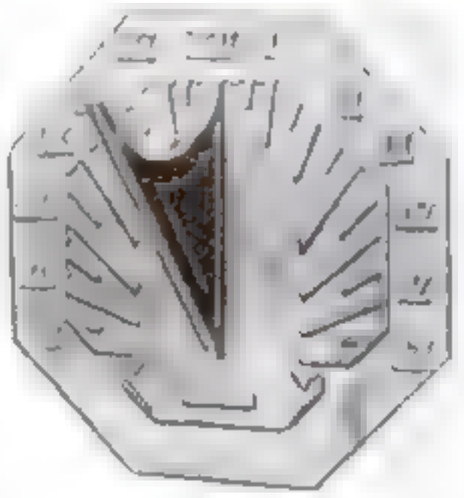
Decorative garden sundial made of two brass castings set on a concrete pedestal

SUNDIALS are as popular today as they were three thousand years ago—but for entirely different reasons. Three thousand years ago they were man's only timepiece; today they are highly regarded as garden decorations.

The earliest of these timepieces was simply a vertical staff set in the earth with a mark of some kind in the soil to point out the noon shadow. This form was, of course, soon improved, and many ingenious contrivances followed. Early dials divided the day into periods and had no connection with solar time. However, just prior to the invention of clocks they had advanced so that they were capable of indicating true solar time with an unusual degree of accuracy. The theory of these highly complicated dials was taught in our early colonial schools before the Revolution, and they were divided into many classes—globe, horizontal, vertical, quadrantal, equinoctial, inclining, declining, refractive, cylindrical, star-and-cross dials, to name but a few forms. With the exception of the horizontal model, these are of more interest to the antiquarian or historian than to the man who plans to build one for his garden.

A horizontal dial, such as the one illustrated, consists of the dial and the pedestal. The dial itself is made in two sections, the gnomon and the face. The latter is a flat plate, divided to measure the shadow the gnomon throws upon it. Although usually made in one piece, the gnomon is composed, in theory, of two parts. The upper inclined surface, which casts the shadow, is called the style, while the lower portion, by which it is fastened to the face, is known as the foot.





The assembled dial and, at left, diagrams for laying out the patterns, together with plans for the pedestal

Construction of the dial face and the gnomon is generally accomplished by making wooden patterns for them. They are then cast of brass or of some other weather-resisting metal. The pedestal is made of wood, stone, pottery, or concrete. The latter material seems to be ideal. It is readily cast into any shape and stands the weather well. Sundial pedestals may also be purchased from large mail-order firms or locally, or the pedestal of an inexpensive bird bath may be used.

The cast concrete pedestal is formed of three sections

Before the actual construction can begin, you will need to lay out the dial and gnomon. As the dial is to be 12 in. in diameter, a fairly large sheet of paper will be required. To be accurate, both the dial face and the gnomon must be figured according to the latitude of the town or city where the dial is to be used. This may be found with sufficient precision by looking at any good map.

Figure 1 makes it very easy for anyone residing in the United States to lay out a dial face. All hour lines have been figured, and all that you need to do is find your latitude under each hour line and draw a line from it to point *A*. Notice that point *A* is not in the exact center of the dial; it is 3/16 in. to the right of it. The hours from six to twelve are projected across the dial, leaving another 3/16 in. between the center line and the point corresponding to *A*. This means that you will have a space ⅜ in. wide in the center of the dial. This is for the gnomon. Half- and quarter-hour lines are equal divisions of the space between hour lines. All markings are made 3/16 in. wide with the exception of the numerals, which are ⅛ in. wide.

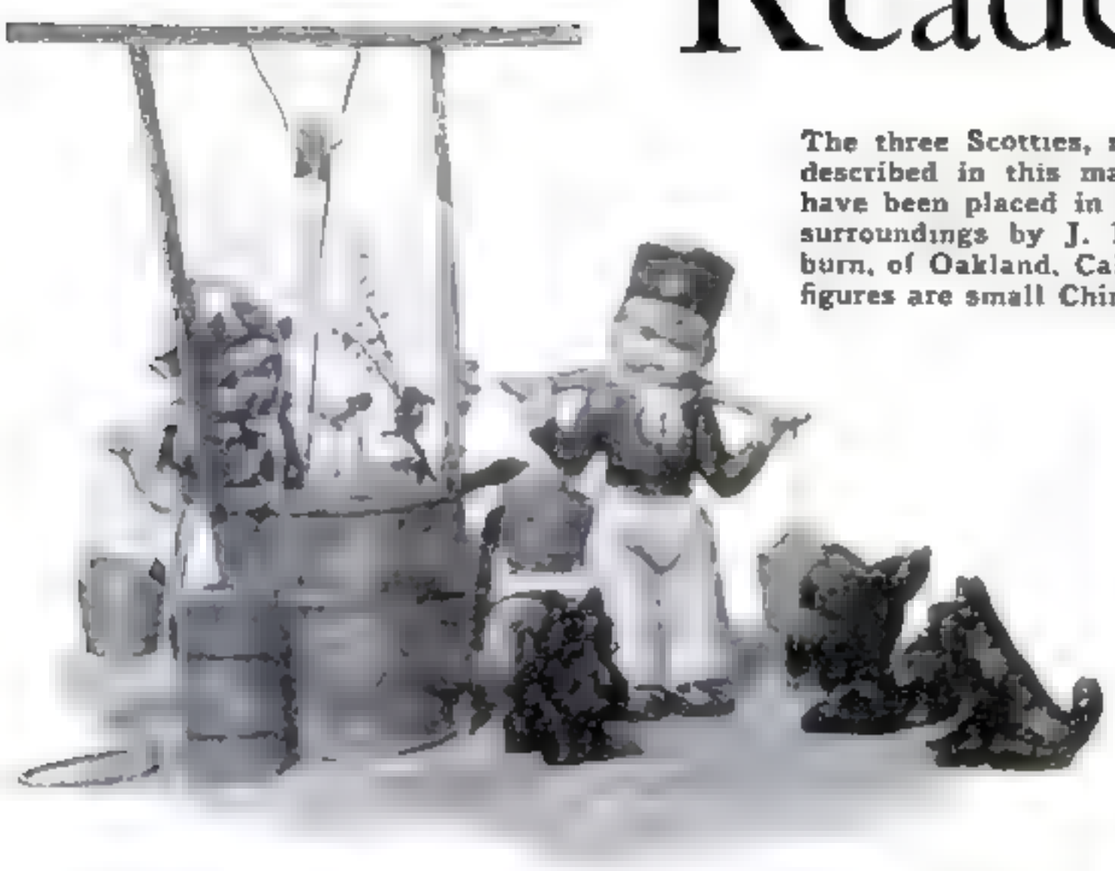
Transfer the drawing of the dial face to a piece of wood, 12 in. square and ¼ in thick. Out of this, cut a 12-in. octagon. Now, glue thin strips of wood, 3/16 in. wide by ⅛ in., over all the hour lines and the decoration at the bottom. The numerals are made of ⅛-in. square wooden strips. A piece of ⅛-in. wood, ⅜ in. wide, is glued on where the gnomon is to be placed.

When every piece has been glued in place, all sharp corners between the strips and the dial face must be rounded in with wax. Sharp edges on the strips are smoothed off with a knife, and finally the entire pattern is sandpapered smooth and given two or three coats of thin orange shellac.

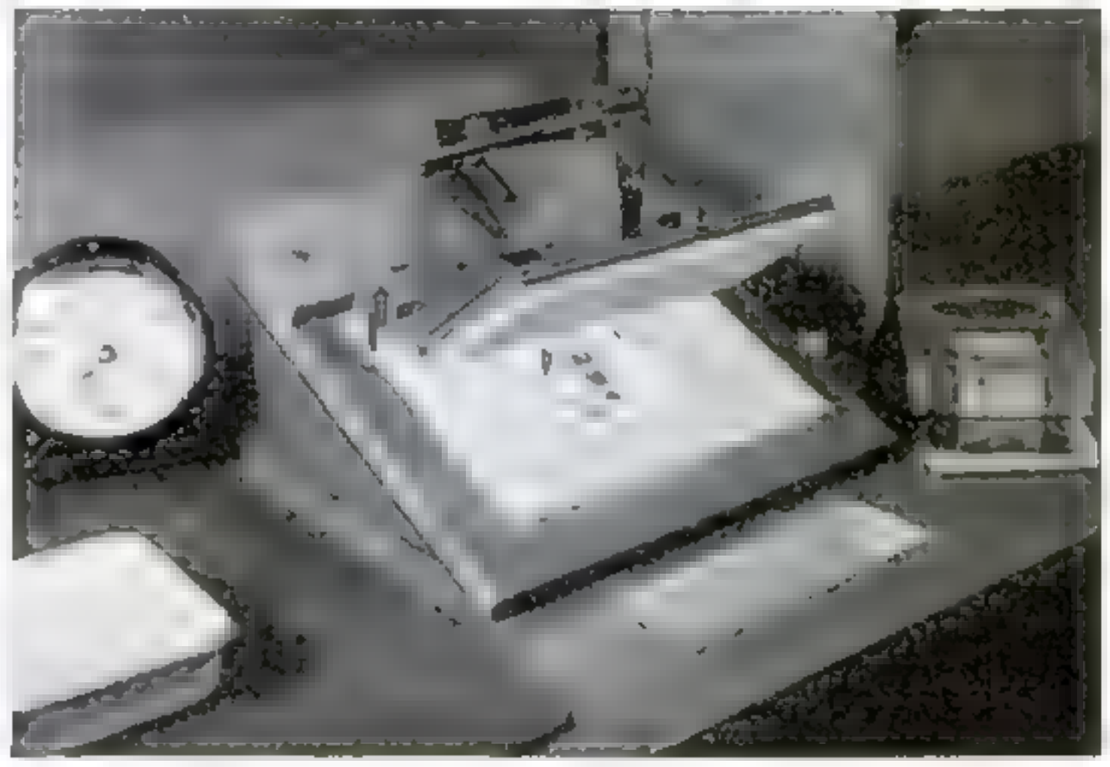
The gnomon is laid out as in Fig. 3. Line *X Y* is 7 in. long for our particular dial. *X Z* is inclined at an angle from line *X Y* equal to the latitude of your location. Point *Z* must be exactly over point *Y*. Radius *R* can be any arc that looks well. A ⅛-in. border is drawn around the edge, and a simple design is placed in the center.

Using carbon *(Continued on page 93)*

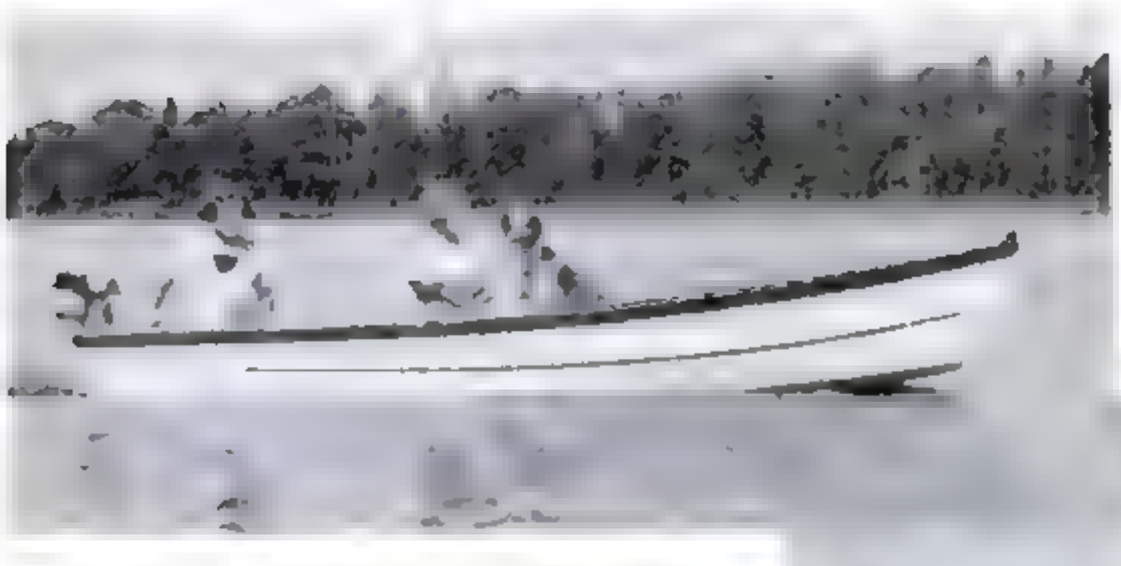
Readers Display Skill IN VARIETY OF CRAFTWORK



The three Scotties, recently described in this magazine, have been placed in artistic surroundings by J. L. Clyburn, of Oakland, Calif. The figures are small China dolls



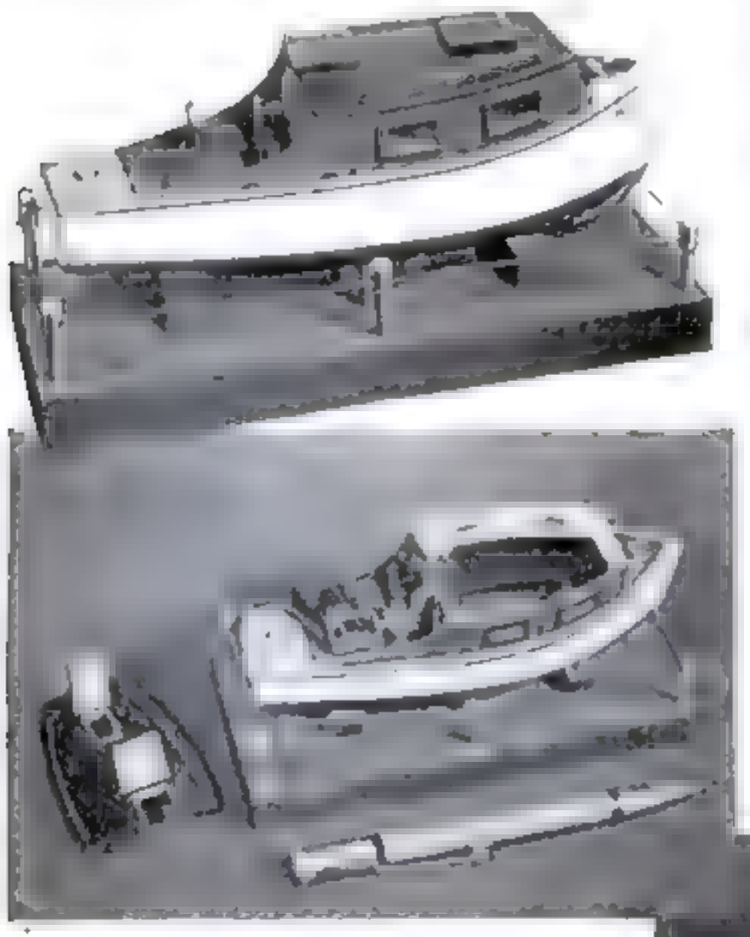
Samuel B. Lawrence, Jr., of Portland, Ore., constructed this darkroom printer from suggestions given in *Popular Science Monthly*. Mr. Lawrence writes that although he did not follow directions exactly, they were of great help. The lamp house is of wood instead of metal



E. Cartwright, of Montreal, made this utility rowboat *Mate* from plans published in *Popular Science Monthly*. Although the boat is shown being operated by motor, Mr. Cartwright has also made a mast and sail for it. These may be attached easily and used whenever desired

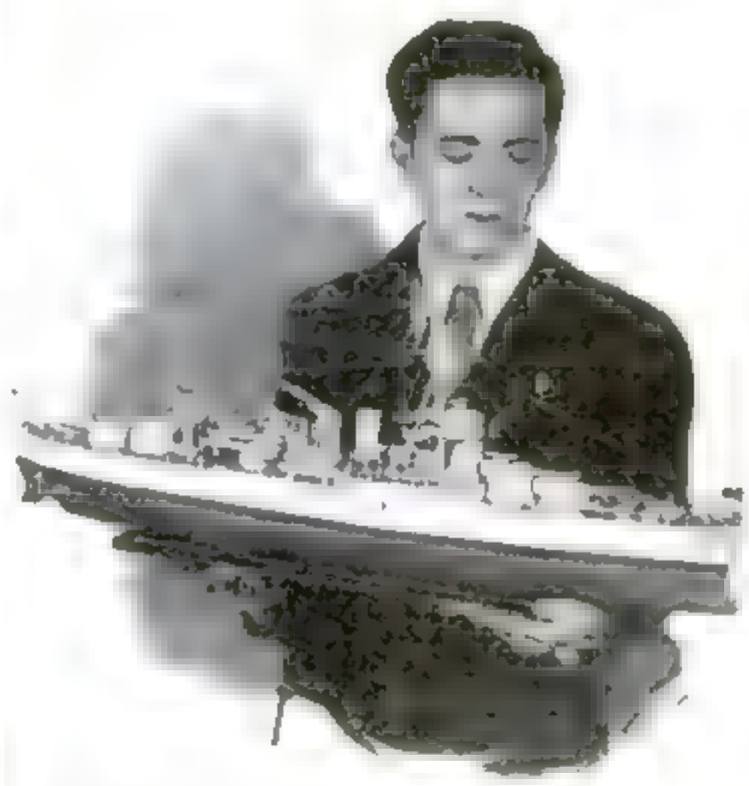
After reading an article on armor and copper work in this magazine, Forrest Grant, of Wilder, Vt., built this model suit of armor. It is 26 in. tall and all parts are movable but the wooden form which is inside

This 15½-ft. sport boat was constructed by H. Franklin Dyer, Auburndale, Mass., from our blueprints. Driven by only a 10-h.p. motor, the boat develops surprising speed



This diminutive 5½-in. motor-boat model was built by E. W. Parsons, Millers Falls, Mass. The upper view shows the assembled boat while the lower picture gives an idea of its relative size. The model was made from a small pine block, some thin tough cardboard, and scraps of wire

Nineteen-year-old Loretta Rogers, of Niantic, Conn., likes to copy New England buildings. The model to the right is of the New London County Court House built in 1784, the scale being ¼ in. equals 1 ft.



It took Albert Maraggia, of East Boston, Mass., 780 hours to construct this elaborate model of the U. S. battleship *Texas*, using our blueprints as a basis. He says he has been offered $150 for the ship by a Navy quartermaster but won't sell it

Sliding Seat

COMBINED WITH

Leeboards

To make sailing canoe faster

By JACK HAZZARD

•

New style leeboards, arranged with thwart and sliding seat, can be made at home quite easily and add much to the speed and efficiency of sailing canoes. The chances of upsetting are less, and your craft will be faster to windward and stronger of hull

CANOE sailing is decidedly "on the make." The American Canoe Association recognizes three distinct classes of sailing canoe, with two or three subdivisions in each group. The most recently recognized group, canvas sailing canoes, will probably create more interest than all the rest together, for in this division practically any 17- to 20-ft. stock model canoe, fitted with sail and leeboards, is eligible. Sail areas range from 55 to 135 sq. ft. in the three classes, and it goes without saying that a sliding seat becomes necessary when more than the minimum area is carried. Some of the rigs use two sliding seats—and need them.

If one of these sliding seats is combined with the leeboard thwart, there is a distinct saving in weight and space, and your canoe will sail better, be faster to windward, stronger of hull, and less likely to upset when running across a puffy blow.

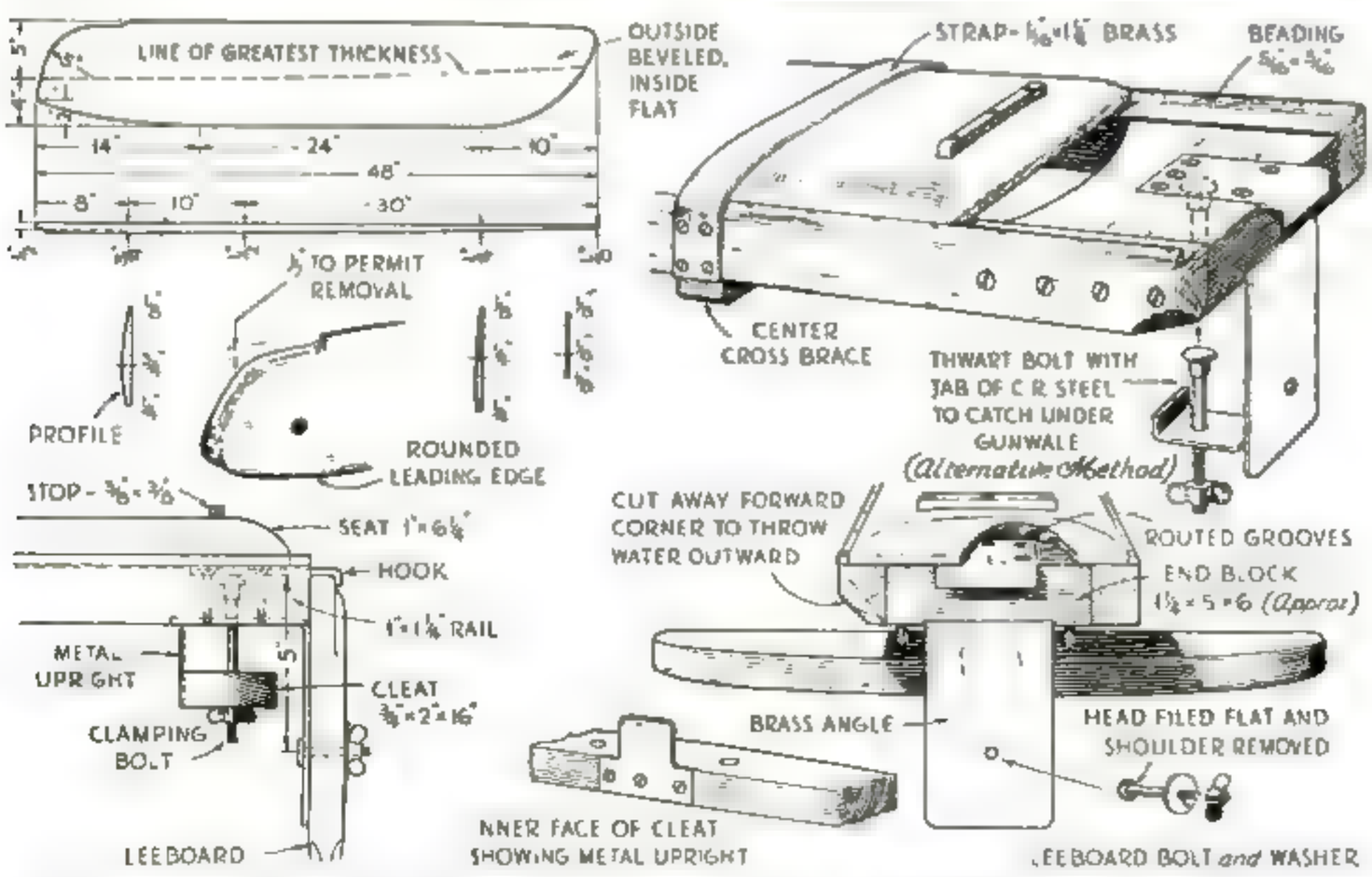
Spruce makes fine, light boards, so do ash, mahogany, and several other woods. For racing, white oak and hard maple, which can be thinned down to the limit, are usually used, but for all-round use, strength, and durability, yellow pine is hard to beat. Two boards are recommended because they aid in accurate sailing.

The upper part of the board, which takes most of the strain, is left ¾ in. thick except where it is shaped to fit under the hook and rounded and tapered at the edges. In the next 10 in. there is a gradual taper to ½ in.; in the next 24 in., to ¼ in.; and from there to the extreme tip, to ⅛ in. These are the maximum thicknesses, located on a line running from the pivot bolt hole to the tip, as shown by the dotted line. All the tapering is done on the outside of the board

Center mark each edge of the board and lay parallel marks 1 16 in. on each side of the center mark along the after edge of the board. On the forward side mark similarly up to 18 in. from the head of the board, and from there up spread the lines gradually to a width of ½ in. opposite the pivot hole. Plane the board from full thickness at the center to the thin edges indicated by the lines just drawn, working, this time, on both sides of the board. Round the leading edge carefully, especially where it is thick up near the head. If the plank from which you cut the boards is "flat grain" as distinguished from "edge grain," it will bend without breaking and is much less likely to split.

Now saw the arc at the head and the curve at the foot. Work in the groove in which the hook travels, and adjust the thickness at points sawn away in bringing the board to shape. Bore for the pivot bolt at the exact center mark from which the arc of the head was drawn. Sand both boards smooth, using a block under the abrasive. Moisten the whole to raise the grain, allow to stand for twelve hours, sand smooth, and apply a thin coat of stain, if desired, followed by shellac. Rub down again with No. 00 sandpaper and finish with two flowing coats of spar varnish. When the second coat is dry, rub the surface thoroughly with floor wax.

To hold the boards to the canoe, a leeboard thwart, *(Continued on page 99)*



White oak and hard maple are best for racing, but for general all-round use, strength and durability, yellow pine is recommended. As an aid in speedy sailing, two boards are better than one

REPAIRING Overstuffed Cushions

By PHILIP MOONEY

Overstuffed cushions, on the verge of breaking apart, can be repaired to last for years

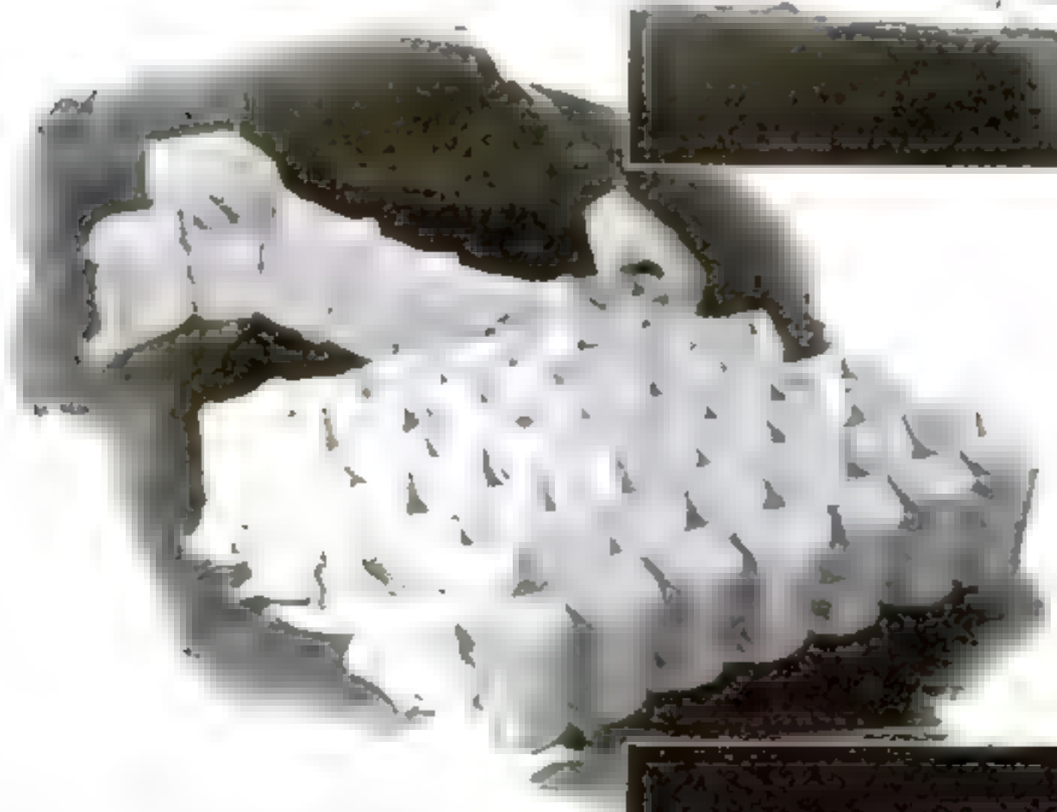
1 The first step is to clip the seam of cover across the back and about 6 in. down each side. The cover is then stripped from cushion like a glove from the hand as shown. Turning back the top layer of padding exposes the springs

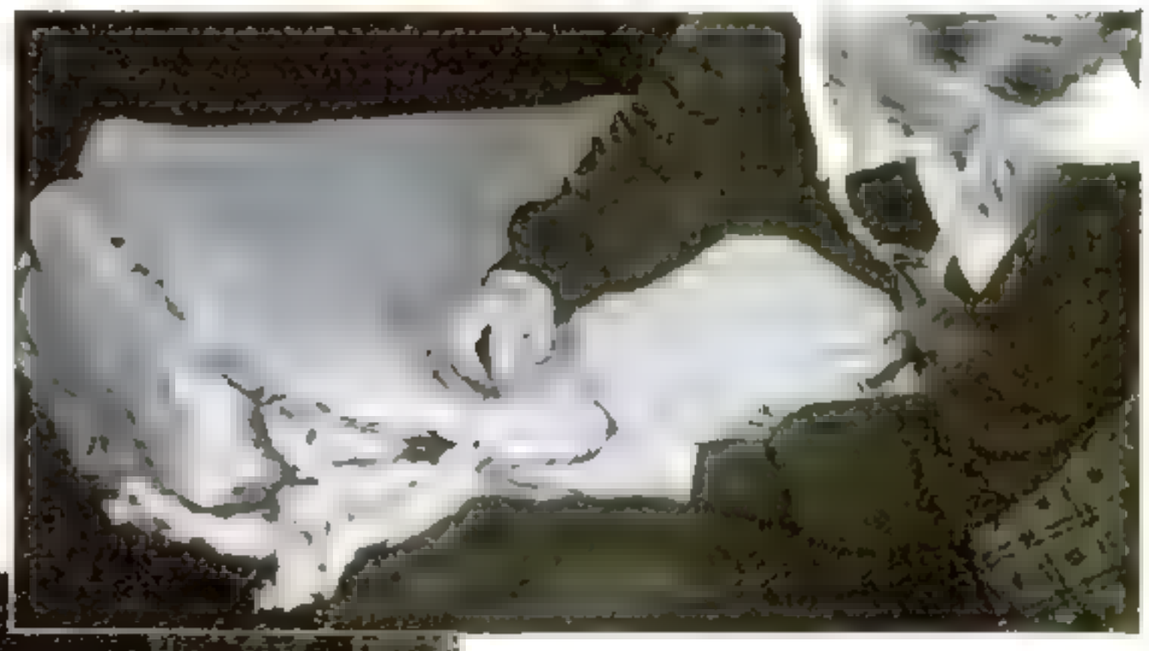
2 The tangled springs may quite easily be separated by unscrewing one from another. Place them in order upon the table to await the new covering

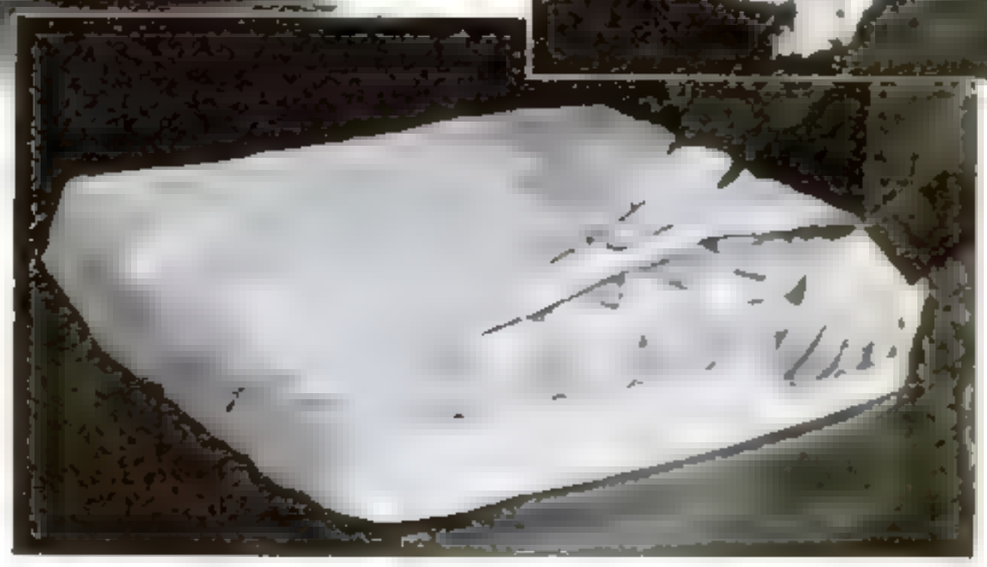
3 Impressions left by the springs should be counted next to find out the dimensions of the spring pad. Then cut a strip of unbleached muslin four times as wide as cover's boxing

4 *Left:* Fold muslin lengthwise. Mark pockets ¼ in. from end and at intervals of 1¼ times spring diameter plus ¼ in., leaving space equal to diameter at end of rows Then double seam pockets as marked

5 *Circle:* Place strip in machine lengthwise. Start closing seam ½ in. from open edge of goods. Compress spring and slip to bottom of pocket. Complete seam across pocket







6 A vigorous shaking will snap the springs into proper position in the pockets. Assemble on a flat surface and tie rows together, top and bottom, with large needle and twine at points of contact of the springs

7 Make a boxed slip cover of muslin for the spring pad, having a very snug fit. Compress springs slightly if necessary in order to pull on as illustrated in photo at the right, making certain that the springs are arranged correctly in their places

8 The final step is to place the spring box between the layers of felt and sew the latter together at the edges with grocer's twine, using a large needle. Then replace in original cover. Any depressions along the edges may be filled out with cotton when cover is pulled on

Safe Photo Intensifier and Reducer

PAGES and pages of formulas have been published in photographic manuals on the subject of negative intensification, but many of the methods are somewhat hazardous when used indiscriminately by the amateur. The following formula, however, can be used with perfect safety if the instructions are carefully followed. It has the advantage of not changing the color of the image on the film, and the worker therefore will not be confused by its appearance when he judges the printing time. It is also most useful for the intensification of color film and plates because of its lack of stain.

SOLUTION No. 1 (should be stored in a brown bottle):

Silver nitrate	1 ounce
Distilled water to make	16 ounces

SOLUTION No. 2:

Sodium sulphite (desiccated)	1 ounce
Water to make	16 ounces

SOLUTION No. 3:

Hypo	1¾ ounces
Water to make	16 ounces

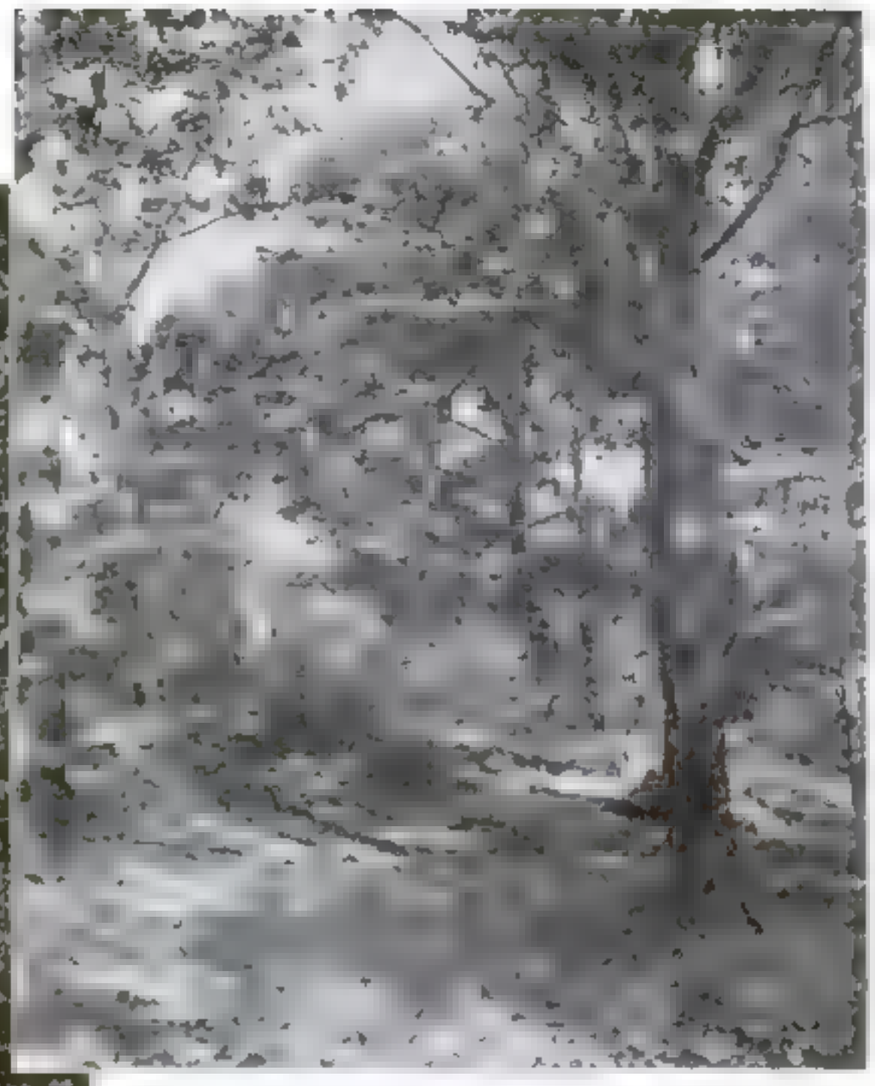
SOLUTION No. 4:

Sodium sulphite (desiccated)	¼ ounce
Metol or pictol	170 grains
Water to make	48 ounces

These stock solutions, which will keep indefinitely, should not be combined until they are to be used. Then add one part of No. 2 to one part of No. 1 and stir thoroughly. A white precipitate will be formed, which is now dissolved by the addition of one part of solution No. 3. Let the mixture stand a few minutes until perfectly clear; then with thorough stirring, add three parts of solution No. 4 and use at once.

The degree of intensification is dependent upon the time of immersion, but do not treat the film for longer than 20 minutes or a general fogging might result. After intensification, place the film in a 25 percent plain hypo solution for 2 or 3 minutes and wash *(Continued on page 85)*

What can be done with a poor negative by skillful intensification is illustrated in these photos. *Below*: Best possible print on contrast paper. *Right*: When intensified



MOUNTING PHOTO PRINTS TO STAY FLAT

A clean cloth sack, partly filled with lake sand, serves as a weight for mounting prints

MOUNTING amateur prints and enlargements can be an exasperating procedure if a liquid adhesive is used, and even dry mounting tissue may cockle a large print if the heat is unevenly applied. A safe method of mounting even the thinnest papers consist of giving the back of the print two coats of a solution made by dissolving a package of colorless table gelatin in 6 oz. water. Apply with a swab made from a tuft of cloth, and let the print dry thoroughly and naturally between coats. Now dampen the mount with clear water and lay the print in place. Cover it with a piece of clean paper and press with a moderately hot iron. Continue applying the iron until the gelatin has had time to melt and penetrate the mount, and then place the picture under a heavy weight until dry. The print will stick to the very edges and will not warp the mount.

Probably the best way of weighting your mounts is to have some sacks of suitable size made *(Continued on page 85)*

TIN-FOIL REFLECTORS FOR PHOTO LIGHTS

DARKROOM lights may be improved by covering them as illustrated in the photograph above with tin foil glued in place with a little water glass or household cement. Lamps so treated will reflect an intensified illumination over what may be regarded as the safe portions of the room and throw a shadow over those areas of the darkroom where a continuous light, even a safe light, is dangerous to the film or paper.

Printing lights treated in the same way will cut your printing time to a surprising degree, as will a similar application to the light in a horizontal enlarger. Likewise, if you cover one half of your photoflood lamps in this manner, you will be able to dispense with reflectors, several of which would otherwise be necessary, especially if you do home portrait work. Be very careful, however, that the tin foil is cut short at the bottom and does not come in contact with the brass end of the lamp.

LIGHTPROOF VENT FOR DARKROOM

IF YOUR photographic darkroom is located in the basement, you may have difficulty in ventilating it properly. A light baffle built somewhat after the pattern of the one illustrated and painted black on the inside will give adequate ventilation provided it is mounted so it can exhaust into the outer air.

Wooden ventilator and light baffle with one of the sides removed

Snapshots this size

with this miniature camera

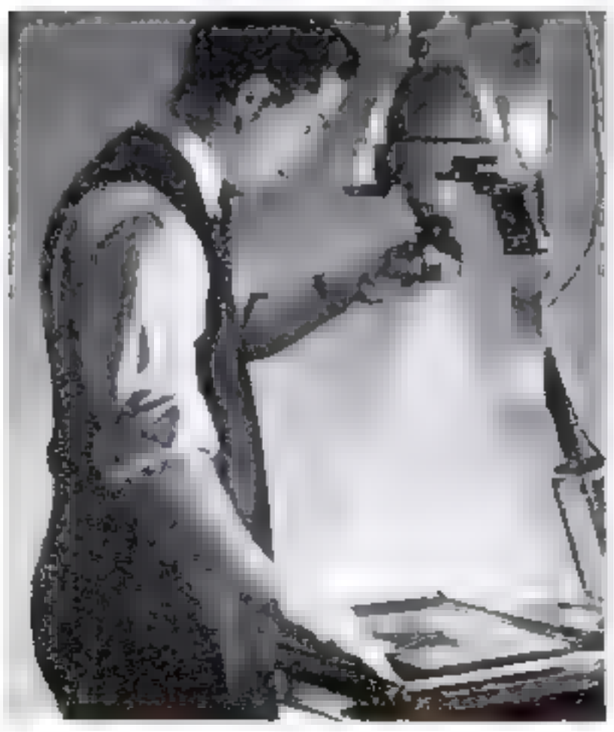
Kodak Duo

a true miniature camera yet it takes a larger picture

KODAK DUO is ideal for the miniature camera enthusiast. It has all the advantages of a small, pocket camera . . . economy, convenience, short focal length—yet it yields a larger picture: Makes sixteen 1⅝ x 2¼-inch pictures on a roll of 620 Kodak Film . . . actual picture size above.

With the high-speed Kodak Duo Six-20, there's no need for posing. The Compur-Rapid shutter, with speeds up to 1/500 second, stops action—covers any exposure requirement. The crisp, keen *f*.3.5 anastigmat lens lets you make snapshots in almost any light—even at night, with Kodak "SS" Film and Mazda Photoflood bulbs. Complete with depth-of-focus scale . . . optical finder—price $57.50. At your dealer's.

CHOOSE THE RIGHT FILM *Kodak Verichrome Film* is an excellent all-around picture maker. Has great latitude, guards you against exposure errors . . . *Kodak Panatomic,* extremely fine-grained, designed especially for miniature cameras. Makes striking enlargements . . . *Kodak "SS" Panchromatic*—extra speed for difficult pictures. Completely color-sensitive. Ideal for snapshots at night with Mazda Photoflood bulbs.



KODAK MINIATURE ENLARGER, MODEL B

Ideal supplement for the Duo. Makes enlargements from Duo negatives up to 16 x 21 inches. Paper cabinet base optional. Enlarger, Kodak Anastigmat *f*.4.5 lens, masking paper holder, iris diaphragm, magnification scale, exposure calculator, $82.50. Without diaphragm, $67.50. Paper cabinet base, $10.

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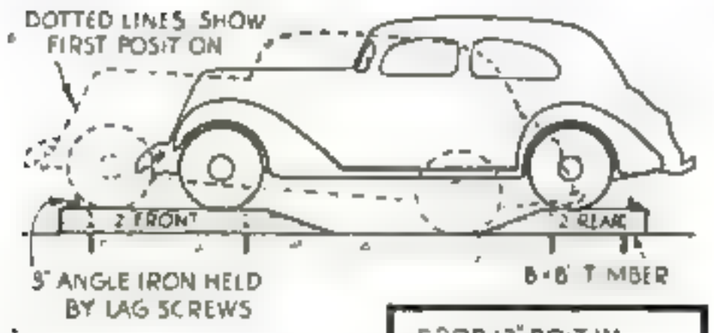
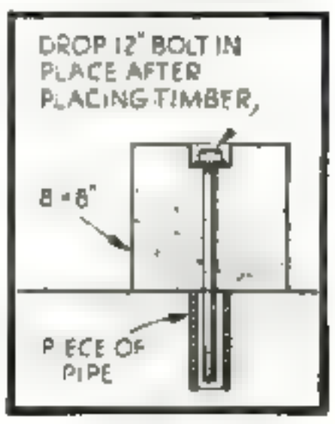
THE MONTH'S BEST

Auto Ideas

Time-Saving Suggestions For Car Owners Made by Our Experienced Readers



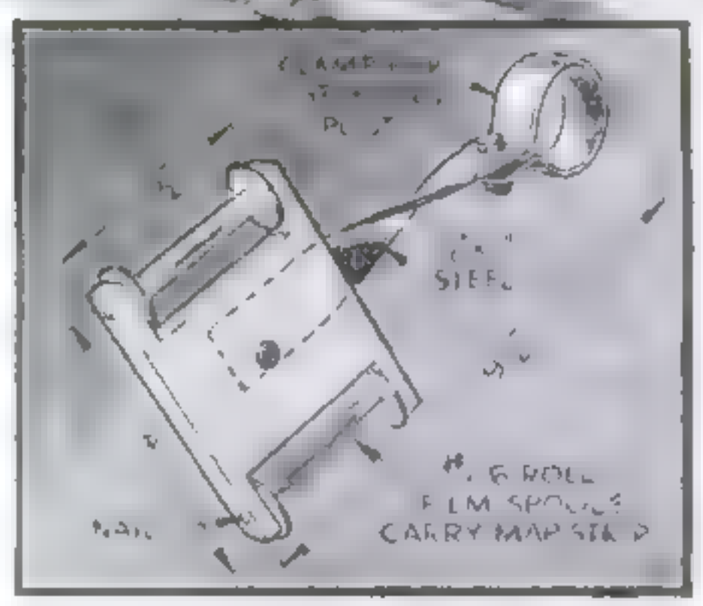
Removable Car Ramp



WITH four beveled blocks as shown above, the home mechanic can equip his garage with a removable ramp. The front blocks are put in place first and the front wheels driven up on them. Then the rear blocks are placed and the car driven in reverse until the rear wheels are raised.—J. D. M.

Roller Map Holder

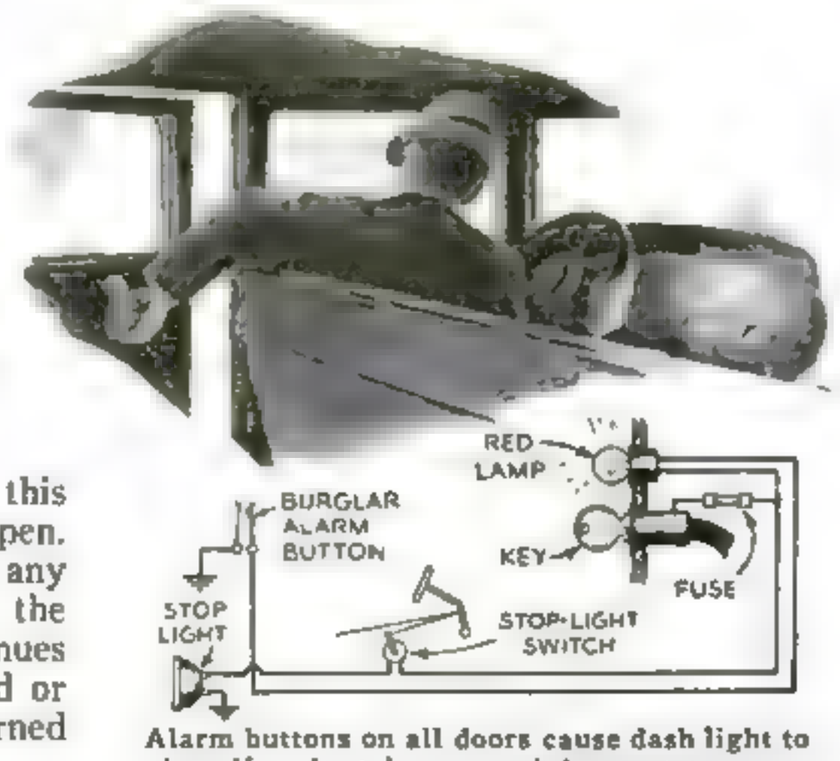
MOUNTED on the steering column of your car, the easily made roller map holder illustrated will simplify the problem of following routes during summer tours. Before the trip begins, cut the map of the route to be followed into 2½-inch-wide strips, paste the sections on a length of wrapping paper, and roll the continuous strip on the two metal camera spools (No. 116) that form the rollers. As the trip progresses, it is necessary only to roll the map from one spool to the other to have always before you the part of the route over which you are traveling.—L. S. S.



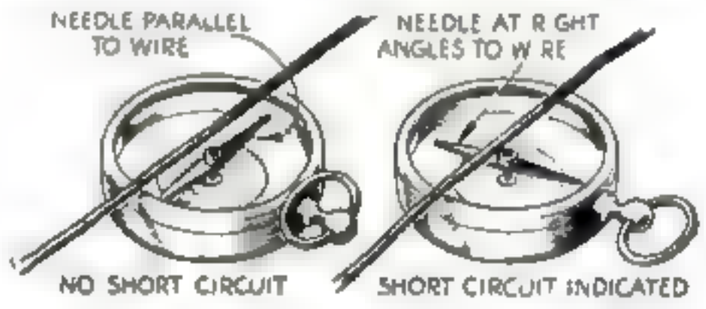
Drawing shows details of map holder and how it is mounted on steering-wheel post

Dash Pilot Warns of Open Car Door

AFTER ripping two doors off my car in trying to back out of my garage, I decided to rig up some sort of telltale that would warn me when I had left a door open. Installing a red lamp on my dash, I connected one terminal to the ignition switch and the other to one leg of an inexpensive push-type burglar-alarm button mounted on each door. These switches are so constructed that they complete the circuit whenever pressure is removed from them, in this case brought about by the door being open. So, when the ignition is turned on and any one of the doors has been left open, the pilot light glows a warning and continues to glow until either the door is closed or the car's ignition switch has been turned off.—M. G.

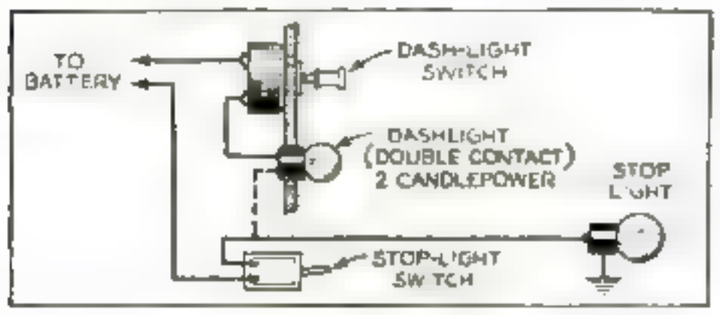


Alarm buttons on all doors cause dash light to glow if a door is open while ignition is on



Tracing Short Circuits

IN REPAIRING car wiring, an inexpensive compass will prove a valuable tool for locating grounded wires that are causing short circuits. Hold the compass in your hand until the needle comes to rest. Then, with both the ignition and lighting switches turned off, place the compass under each wire in such a way that both the wire and the needle line up. Any wire carrying current due to a short circuit will be its own detector, causing the needle of the compass to swing to a position at right angles to itself.—D. B.

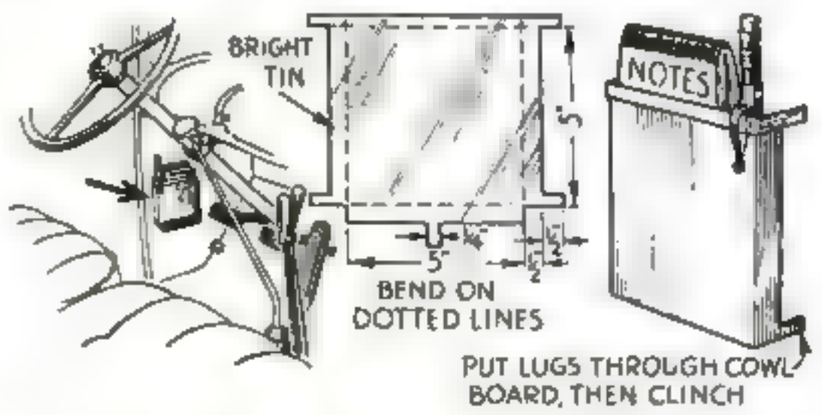


Stop-Light Telltale

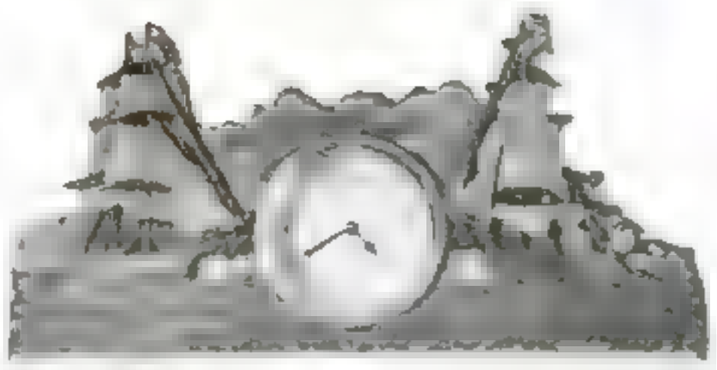
ANY double-contact dashboard light can be made to serve as a stop-light indicator simply by substituting the one wire shown by the dotted line in the diagram for the bulb ground connection. When the stop light goes on, this light dims.—G. C. C.

Notebook and Pencil Holder

THE problem of storing a notebook and pencil in a car so that they will be handy to the driver can be simplified by installing a holder on the left-hand cowl board. A suitable pocket can be made from a five-by seven-inch sheet of tin cut from an old can. Shaped as shown, it can be attached to the side panel simply by pushing the short lugs through slits and clinching them on the inside. Besides notebook and pencil, the holder can be used as a storage place for the spare-tire key, insurance accident report, sun glasses, and any other small articles that the driver likes to have handy when he is on the road. Artificial leather glued to the outside of the pocket after it is in place will improve its appearance.—D. J.



COLORED WOOD CARVING MADE FROM PICTURE



Clock stand carved to represent an engagement between two brigs in the War of 1812

CONSIDERABLE art and skilled handling of tools are required to carve a picture in high or low relief. The lower the relief, the more art and knowledge of perspective are necessary; and the higher the relief (that is the deeper the cutting), the greater the tool skill. A pleasant variation that makes the task somewhat easier is to color or polychrome the carving

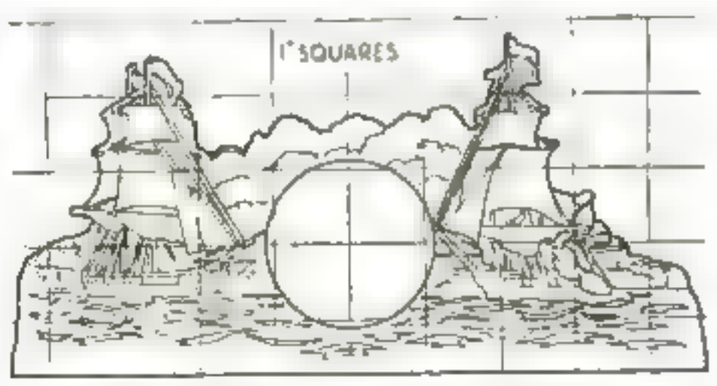
The example shown is a clock or watch stand representing Walter Lansil's picture of the engagement between U.S.S. *Enterprise* and H.M.S. *Boxer* near Portland, Me., September 5, 1813. Both were brigs. The *Boxer* surrendered after both ships had lost their commanders. Other similar pictures could be simplified and used in the same way.

Any wood about ½ in. thick and hard enough to resist the chisel will serve. I used a piece of German pear, 5 by 10 in.

Smooth the wood on both sides, shellac it lightly, and draw the pattern, preferably inking in the lines. Carve the ships, clouds, and sea in the usual way. Get as much perspective as the wood will allow, to represent both vessels as if coming out toward the center, with their bowsprits touching the center rim and their sterns deeply cut. The clouds should be cut well back and the sea left on the high level, with the waves incised.

The center may be cut out to take a small clock or barometer, or it may be merely sunk a little to allow a watch to hang level from a hook above. Make sure of the size before laying out the design, because the ships can be separated or closed to fit. A separate base may be screwed on, if necessary, to make the piece stand firmly upright.

Now shellac the parts that are to be left natural, but nothing else. In the example illustrated, everything is tinted except the sails.



How to lay out the design. The ships may be shifted to suit any size circle required

I stained the masts, rigging, and hulls a dark oak. The sea is stained green, with ultramarine rubbed into the hollows. On the sky I rubbed some sky blue (cobalt) with a touch of white toward the top edges of the clouds. To represent the smoke at the horizon, I rubbed on a little white. The flags are scarlet. I gave one vessel red ports, and the other a red stripe to distinguish them.

Colored stains are the best, but thin, transparent artist's colors are nearly as good, with here and there a touch of stronger color or even a bit of gilt. The clouds might be silver or sunset gold instead of white. It is not necessary to be too naturalistic. Give the whole carving a coat of flat varnish when it is finished.—P. O'N.

MODERN-LOOKING

Novelties from Old Bottles

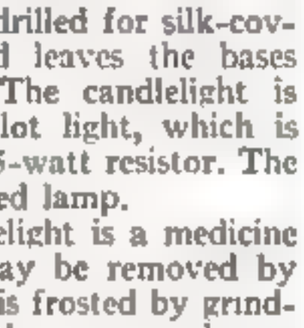
Electric candlelight. The tube—an old medicine container—is frosted with emery and water as at right

SMART, modern, and distinctive novelties may be made from old bottles by any woodworker with a lathe for turning the wooden bases, tops, and other necessary parts. The glass may be frosted to a pure white, and the wooden parts finished in glossy black enamel and silver paint.

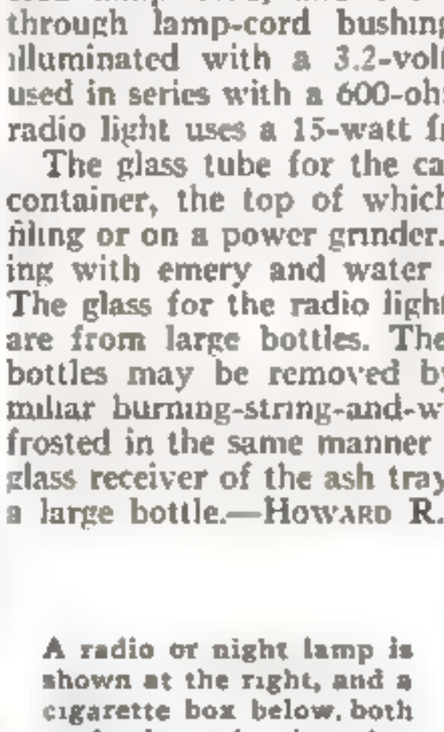
All the articles illustrated were turned from soft pine. The lights have channels drilled for silk-covered lamp cord, and the cord leaves the bases through lamp-cord bushings. The candlelight is illuminated with a 3.2-volt pilot light, which is used in series with a 600-ohm, 5-watt resistor. The radio light uses a 15-watt frosted lamp.

The glass tube for the candlelight is a medicine container, the top of which may be removed by filing or on a power grinder. It is frosted by grinding with emery and water in the manner shown. The glass for the radio light and the cigarette box are from large bottles. The tops and bottoms of bottles may be removed by filing or by the familiar burning-string-and-water method. They are frosted in the same manner as the candlelight. The glass receiver of the ash tray is the bottom part of a large bottle.—Howard R. Heydorf.

How the edges of the glass ash tray are ground; above, the complete tray



A radio or night lamp is shown at the right, and a cigarette box below, both made from bottles that have been frosted white



At the right are given the drawings for all four pieces. Note that the dimensions for width are to the center line

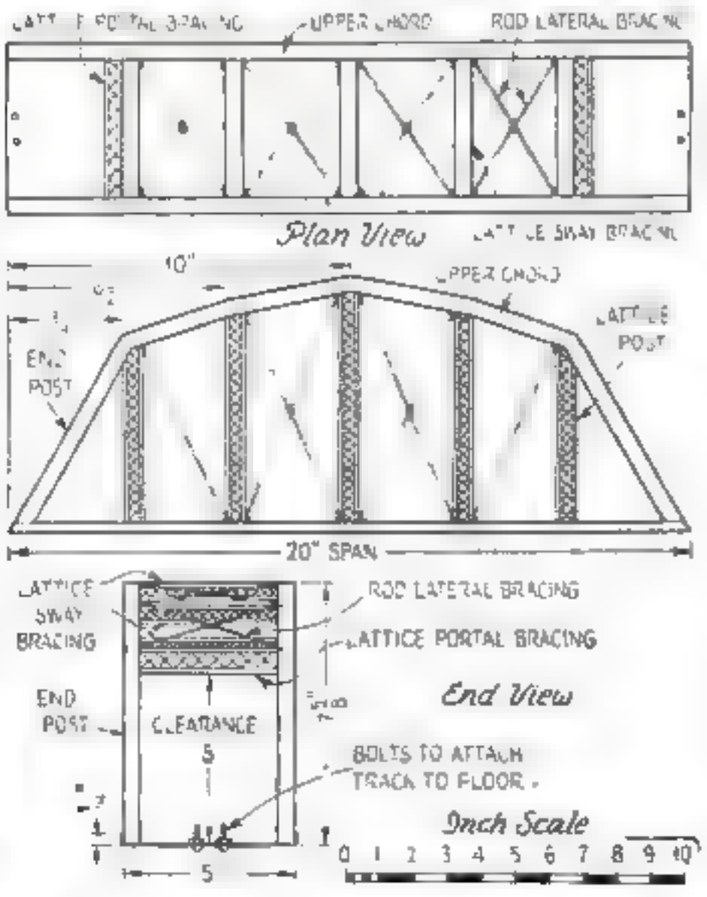
HOW TO BUILD A BRIDGE FOR A MODEL RAILWAY

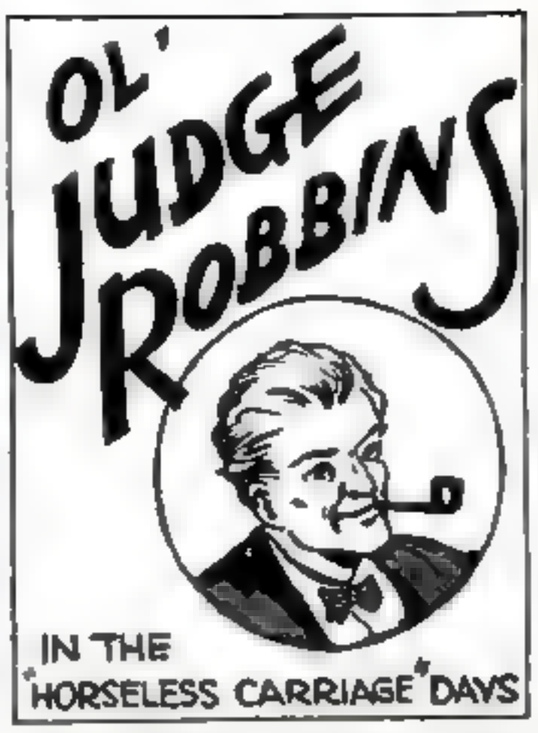
THE accompanying illustrations show a six-panel through bowstring truss bridge for an "O" gauge model railroad. It was made from 24-gauge galvanized ingot iron, fly-swatter handles, and No. 4 mesh hardware wire. One desirable feature is that it may be placed directly on the floor.

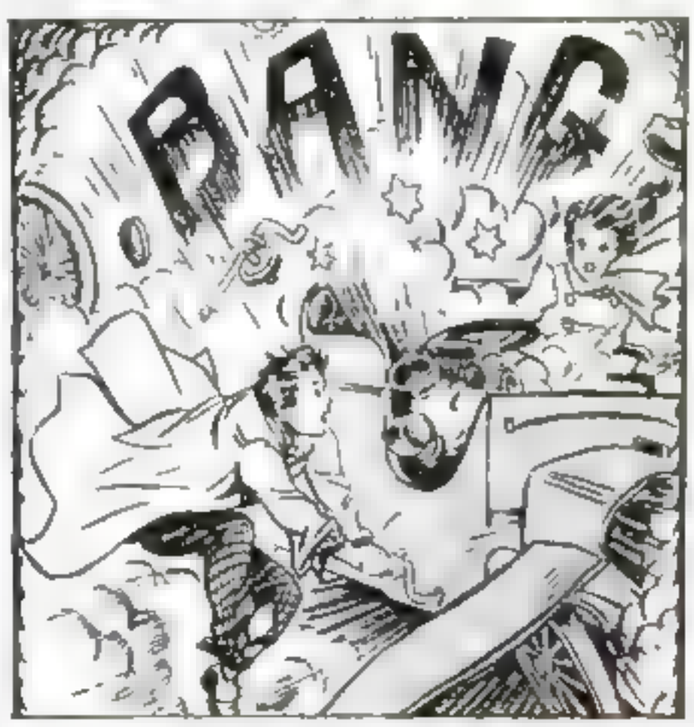
Every joint was soldered, and the structure is sturdy enough to support a 200-lb. man. When completed, it was painted aluminum.

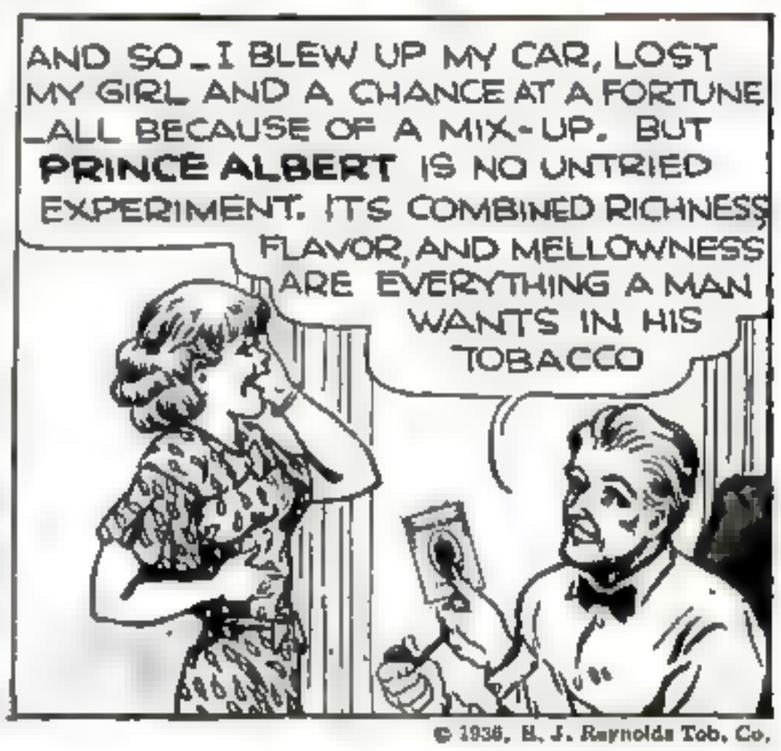
The floor metal is cut 20 by 5½ in. Both edges of the span are turned up ¼ in., forming a right angle on each side to which the posts are soldered. The upper chord is cut in one piece, 28 by 1 in., and bent lengthwise to form an angle iron of ½-in. face.

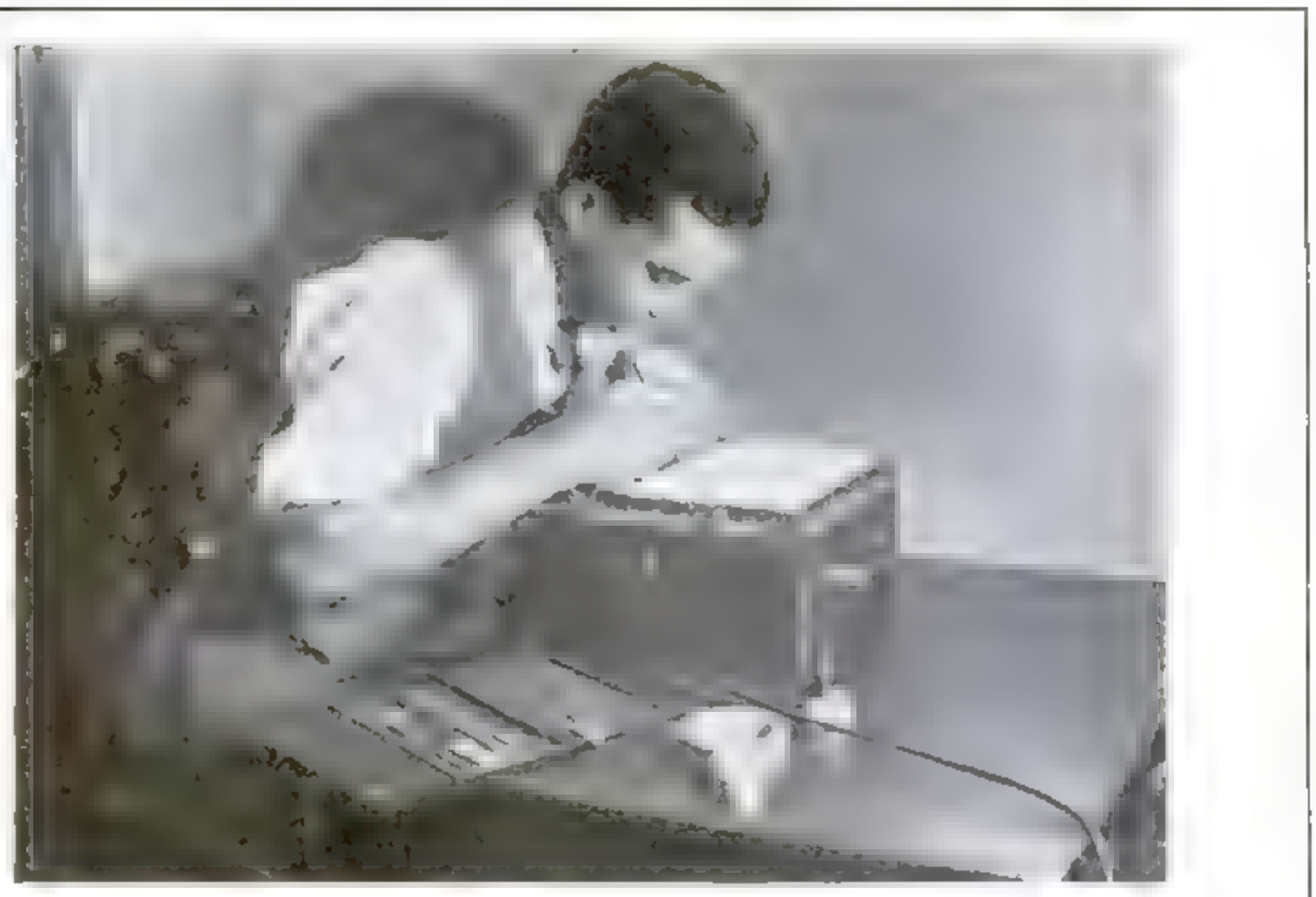
All latticework is made by cutting hardware wire on the bias. The posts and sway braces are cut ⅝ in. wide. Turn ⅛ in. at right angles and use as a base to solder the lattice in place. The portal bracings are made by soldering lattice to strips of ingot iron ¼ in. wide and 1 in. apart. The rod lateral and diagonal bracings are made with steel wire taken from fly-swatter handles or other wire about 3/32 in. in diameter.—MAURICE B. HARTSOCK.











Illuminated Tracing Box

AIDS IN DRAFTING AND DESIGNING

By W. E. Stephens

IF AN electric tracing box like that illustrated is made, it saves much time, eyestrain, and annoyance. Drawings and sketches no longer have to be held against a window pane or some other makeshift arrangement when it is desired to make tracings of them. Draftsmen and designers will find this device useful in connection with their work and will be pleased with its small cost as compared with any corresponding commercial equipment. Children, too, will be fascinated by the way in which they can make accurate reproductions of animal pictures by using the box.

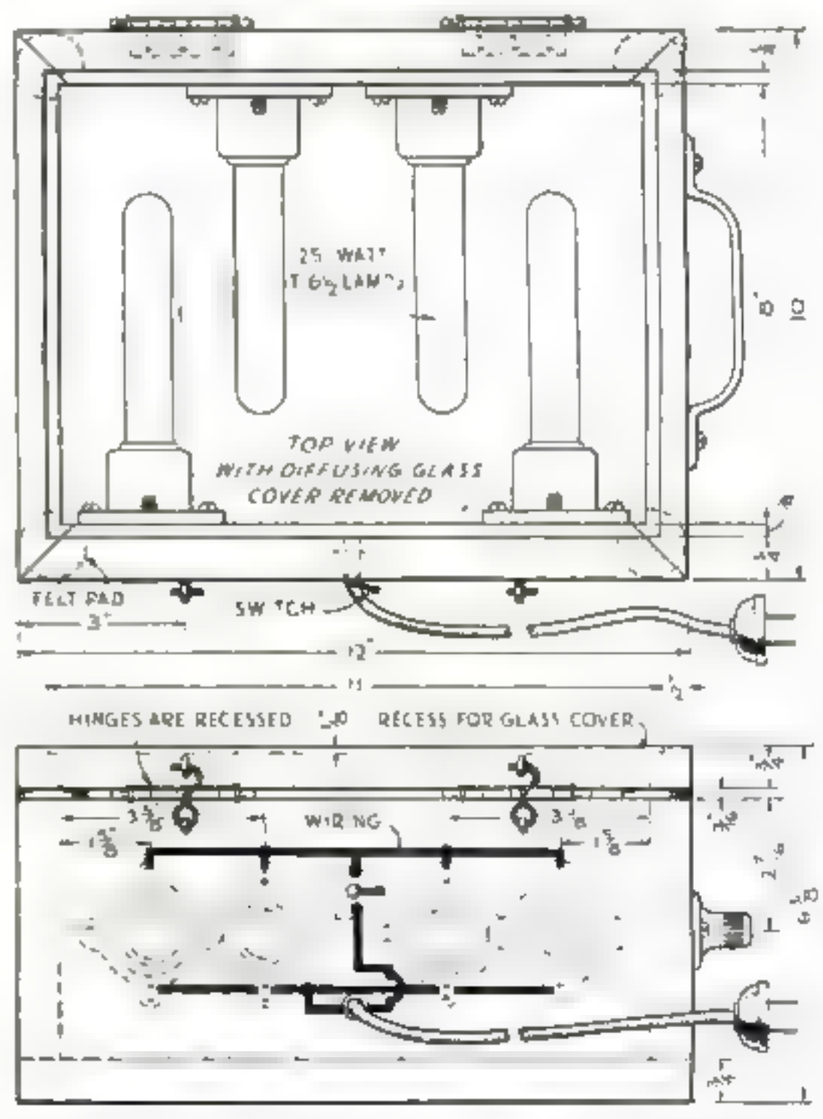
The case proper should be made first from ¾-in. white pine. The sides and bottom are assembled by means of flathead screws, which are countersunk and covered with crack filler.

The frame for the glass, which is made of the same material, is recessed ⅛ in. to admit the 8½ by 11-in. glass cover. This frame is hinged to the box proper, but a 3 16-in. gap should be left between them for air circulation. A piece of felt is glued in each corner between the lid and the box so that the gap will be uniform all around. Small hooks and eyes are used to hold the lid in a closed position.

Any cracks in the assembled box should be filled so as to prevent the loss of light. The interior is painted with a high gloss white enamel to make it as reflective as possible

The lamp sockets should be located as shown in the drawing in order to obtain the maximum amount of light with a minimum amount of glare and shadow. The four lamps used are 25-watt and of the type designated as T-6½. If sockets for these lamps are not obtainable, it will be necessary to use adapters and standard size sockets, because these lamps have an intermediate base. The wiring is relatively simple. The lamps are connected in parallel, a switch is inserted in the circuit, and an optional length of lead-in wire runs from the case. White-covered wire should be used for the wiring inside the box.

The outside of the box may be painted any color, but green is recommended. The glass plate is the last to be put in place. This glass preferably should be of the diffusing type, such as water-crystal flashed opal, but ordinary glass may be used. A good china ce-



Two views of the tracing box with wiring diagram. Run wires around sides of box, not directly across

ment is used to glue the glass into the recess.

A piece of felt glued to the bottom of the box will prevent scratching and improve the appearance. Usually it is not necessary to use all four lamps at the same time, in which case merely unscrew one or two of them.

In many cases it is not necessary to fasten the paper, but when this must be done, I have found drawing tape to be satisfactory. With this tape there are no bumps on the drawing surface to interfere with T-square and triangles, and the paper will not be torn

List of Materials

WOOD

No. of Pieces	T.	W.	L.	For
2	¾	5-7/16	12	Front and back
2	¾	4-11/16	8½	Sides
1	¾	8½	13	Bottom
2	¾	1	12	Molding
2	¾	¾	10	Molding

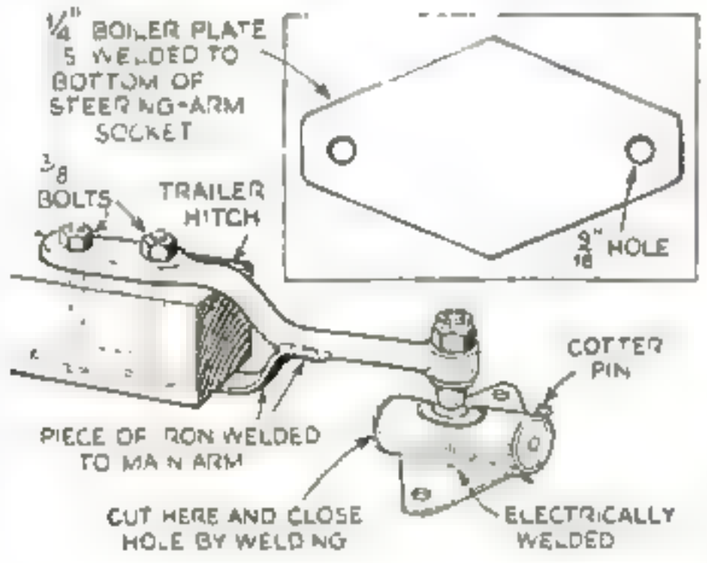
NOTE—Dimensions are given in inches and are finished sizes.

MISCELLANEOUS

1 pairs hinges, 2 hooks and eyes, and 1 handle
Screws, felt, crack filler, and transparent cellulose china cement
1 pc. diffusing glass 8½ by 11 in.
4 lamps, 25-watt T-6½, 110-120 volts; 4 sockets, 1 switch, lamp cord, and plug.

HOMEMADE BALL-SOCKET HITCH FOR TRAILER

THE trailer hitch illustrated in the sketch below has been used for all kinds of loads and over all kinds of roads without failure, and it cost very little to make. A drag link and steering-arm ball-socket joint from a large car or truck are obtained at a wrecking yard. A piece of ¼-in. boiler plate, cut and drilled as shown, is welded to the bottom of the socket, and the hole in the end of the socket is welded shut. Be sure, of course, to remove the spring and adjustments from the socket before doing the welding.



How the steering-arm ball-socket joint from a large car or truck may be used as a hitch

The steering arm can be heated and drawn to any shape desired and made to fit any type of trailer tongue. A piece of iron is welded to the main arm and shaped so as to come under the tongue to give added strength.

The whole unit is bolted to the tongue. Two holes are then drilled in the bar on the car to correspond with the holes in the boiler plate. The trailer is coupled and uncoupled by means of these two bolts, not by removing the ball from the socket.

The completed hitch does not rattle and always gives a steady, even pull with free action in all directions.—L. P. BUNDY.

• • •

THE paper from a cigarette, emptied of tobacco and twisted, makes an even burning fuse for igniting flash-light powder and similar materials.—W. K.

AN EXPERT TELLS YOU HOW TO TAKE CARE OF FISHING TACKLE

(Continued from page 29)

wrapping a rod which has taken a set, it is not advisable to turn the rod over and reverse the guides in an attempt to correct the bend which previous strain has caused. A rod section can be stretched on one side and compressed on the other. After it has become accustomed to this stretching and compression, it is not safe to reverse the direction, since this is almost sure to break it.

Wrappings are unnecessary on light rods of good quality, except at the ferrules and guides. In overhauling a rod, remove the old varnish carefully to avoid injuring the outside bamboo enamel. Fasten a length of thread or line to a stationary object, so that the wrapping may be put on tightly. Lay a short length of thread vertically along the rod, and start wrapping across the thread. Hold the rod in both hands and turn it slowly, directing the thread evenly and tightly.

WHEN you are four to six turns from the end of the wrap, lay a short, doubled piece of thread under the wrap with the loop toward the unfinished end, and make the remaining turns. Cut the end of the wrapping silk and pass it through the projecting loop of the short piece of thread. Pull this end through under the wrap and trim it closely. Before varnishing, rub each wrap gently with a round pencil. This will close the gaps between the wrapping silk. By singeing the wrappings lightly with a smokeless flame you can remove any fuzz and obtain a smoother finish with several coats of rod varnish.

Rods should be inspected frequently to check against wear in the guides, because a worn guide will surely result in a ruined line. Before a rod is put away at the end of the season, it should be carefully gone over to determine whether it needs revarnishing. Incidentally, you should never shellac a fishing rod, because shellac is not flexible. Three or four thin varnish coats will provide ample protection to a rod during a season's use.

No matter how fine or expensive your rod may be, its importance is shared by the line, since it is the line that is cast rather than the fly. Mistaken advice probably causes as much deterioration of fly lines as wanton neglect Many anglers make a practice of greasing their lines heavily at the close of the season's fishing, and sometimes put them on reels.

Line dressing, and there are a number of good prepared dressings, should be used only to clean the surface and pores of the line. After a prepared dressing has been applied and thoroughly rubbed into the line two or three times, the line should be passed through a clean, soft cloth or chamois twice the number of times used in applying dressing, to remove all the preparation. Soft chamois or the palm of the hand is best for the final polishing.

IF THE line is greased to make it float, it should be thoroughly wiped before being put away. Under no circumstances should animal fats be used. Avoid bear grease and deer grease like the plague. Do not put a line away on its reel after the season closes. It may be conveniently cared for by stripping it loosely into the bottom of a cardboard box, covered with a perforated lid to permit free circulation of air. Keep it in a dry place. During the fishing season, the line may be stripped from the reel onto a piece of newspaper and placed in a corner or under the bed to dry, or wound on a collapsible metal drying reel. It may be dressed before being used again.

Braided-silk bait-casting line requires more care than it usually receives. Most anglers use a line that is much heavier than is necessary. Lighter lines are easier to cast without backlashes or snarls than a heavier one. At the end of the day's fishing, the line should be removed from the reel and placed on a large, wooden drying reel for thorough drying. This type of line requires no dressing, and should be stored on the drying reel during the closed season.

The ocean line requires just about the same care. It is not necessary to wash an ocean line in fresh water, but it should be taken off the reel and dried after every wetting. Any waterproofing process used on Cuttyhunk or ocean-fishing line will tend to weaken the line, partly because linen is stronger when wet. Also, any waterproofed-silk or twisted-linen line acquires the tendency to backlash or snarl.

ANY one of several simple knots may be used to attach a leader to a line. The simplest consists of passing the line up through the leader loop, then passing the end under and around both sides of the loop and back under the line. After it is drawn tight, this knot will hold and is not wasteful of line. Its principal advantage is its small size. Never neglect knots accidentally thrown into the leader, as they weaken it.

To build or repair a leader, use the barrel knot, which is illustrated. First, lay the end held in the left hand over that held in the right, and grasp the intersection with the thumb and forefinger of left hand. Make several turns with the loose end, experimenting until the number of turns is most suitable for the size of gut used, then lay the loose end over the leader held by the left hand. Now, grasp the entire knot with the thumb and forefinger of the right hand. This will hold open, outside the thumb and forefinger, a loop which will be used later. Pass the loose leader end over toward yourself and make several turns with the ends, then pass the end held with the left hand through the loop.

If these loose ends are shortened and held, perhaps with the teeth, there need be very little waste. By pulling out with both sections of the leader, the knot will be completed. Clip the projecting ends very closely. This knot may be made with two or more turns. It will hold securely, and the clipped ends will not catch moss. Nail clippers or a razor blade may be used to clip the ends.

To splice a line, fray out each end with a needle for about one inch. Make sure all oil and grease are removed from the line. Divide each frayed portion into two equal parts and fit them together much as you would interlace the fingers of your two hands, bringing the ends of the unraveled line tightly together. Wrap the joint tightly to hold it in place temporarily. Then proceed with a permanent wrap just as you wrap a rod, backing the temporary wrapping off as the permanent wrap proceeds. Finish with the same tie used on the rod, roll between two smooth surfaces, and touch lightly with lacquer or varnish. Wipe off all surplus lacquer and dip in powdered graphite; then polish with a cloth.

HERE are a few valuable tips for the fly fisherman:

Your success will depend, first, on the way you present the fly to the fish and manipulate it after delivery; second, on the size and pattern of the fly; third, on the color of the fly. Of least importance is the fly's physical resemblance to an actual insect. Try changing the size of the fly before switching patterns

To make a fly float, rub line dressing well into the wings and hackle.

In mounting a new processed line on a reel, turn the roll of the line to prevent kinks. If such a line becomes twisted, draw it for some distance over a lawn.

Always keep your *(Continued on page 83)*

HOW TO TAKE CARE OF FISHING TACKLE

(Continued from page 82)

line as straight and tight as possible. Never fish with a kinky leader. A leader properly soaked may be stretched straight without difficulty. A dry leader may be straightened by drawing it between two rubber surfaces, such as a folded piece of inner tubing about two inches square.

Soap rubbed on the dry-fly leader will cause it to sink and thereby lessen the shadow it will cast.

Be sure to wipe all moisture from the rod before putting it away.

Leaders may be dyed or tinted by soaking in tea or coffee, or by the use of aniline dyes. Avoid vivid colors, and do not dye leaders used for dry-fly fishing; the background against which the dry-fly fisherman's leader appears is the sky as seen through the surface of the water from below.

PROTECT your fly rod against undue strain. Never lift even a small fish from the water with the rod. Lead the subdued fish near and slide a hand down the leader within a foot of the fish. When he has ceased struggling and is suspended nearly vertical in the water, lift him gently and swing him ashore. If you have a net available, lower it into the water and lead the fish over it. Net the fish head first.

Not all emergencies can be anticipated, but if you will include in your kit the following items, you will be able to make all ordinary repairs and keep your equipment in first-class condition:

Small pliers.
Small screw driver.
Abrasive stone.
Ferrule cement.
Adhesive tape for hasty repairs.
Small scissors
Nail clippers for trimming leaders.
Rubber for straightening leaders.
Lambskin bag for reel.
Line dressing.
Aluminum rod case.
Goose quill.
Fish-cleaning knife.
Lambskin fly book
Aluminum dry-fly box.

Only a few words need be said about winter care of equipment.

Most trout fishermen discard flies when they become worn. Both trout and bass flies may be cleaned by thoroughly washing them in mild soap suds, rinsing, and drying. In storing any feathered lures, it is well to sprinkle moth crystals among them.

Spinners should be thoroughly polished and dipped in a thin solution of clear lacquer at the close of the season, since much of their value is lost if they become tarnished.

ONE of the most valuable adjuncts to an angler's kit is a small, finely ground abrasive stone for the sharpening of hooks. Bass plugs should be thoroughly washed and touched up with enamel or lacquer to restore their original brilliance. It is well to apply oil in small quantities to all fittings and hooks.

Many anglers are now using glycerin instead of water to soften their gut leaders. This is a wise procedure, for glycerin causes less deterioration than water.

Fly-casting and bait-casting reels, of course, should be frequently oiled and greased, both during the season and when storing for the winter. It is well to have a special bag of leather for each reel. A good bag of this sort is made of waterproof lambskin with slide fastening. Salt-water reels require frequent care, since the slightest neglect will cause serious corrosion. This corrosion is very destructive of lines and would eventually ruin the reel.

Old Bill SAYS:

DON'T think that an oilstone is intended only for carpenters' tools. An occasional touch to the cutting edges of a drill or reamer will extend the time between grinds. In fact, stoned cutting edges stand more feed and speed.

. . .

Speaking about hack saws, the number of points should not be confused with the teeth per inch. A ten-tooth saw has eleven points.

When using carbide-cemented tools, remember that rigidity is the main factor, because the feed is usually increased 100 percent.

. . .

The safest way to stone the edge of a planer knife is to clamp a parallel bar at the bottom of the bevel; this will act as a guide for the stone and prevent turning the edge over.

. . .

The feed of a tap is regulated by a positive lead, and in proportion to its cutting edge a tap removes more stock than any other metal-cutting tool. Taps therefore require much attention and must be kept sharp.

. . .

To harden a cylindrical piece of unusual length and diameter, heat as required and while revolving it in an electric drill, immerse slowly in a vertical position.

. . .

If you experience trouble in getting parallel results with the surface grinder, it is because the wheel spindle and the longitudinal table are not precisely squared. This error is usually due to wear in the spindle.

BLUEPRINTS GIVE EXPERT GUIDANCE

NO MATTER how much or little time you have for your home workshop activities, it pays to concentrate your efforts on worth-while projects. To help you do this, we offer a series of blueprints prepared by experts. The following list gives a wide selection, but many other prints are available. Send a stamped and self-addressed envelope for our complete list

A set of two new blueprints is available this month with full-size plans for making a scale model of a 165-ft. Coast Guard patrol boat. The hull of the model is 20¾ in. long. If you wish these prints, order Nos. 286 and 287 and send fifty cents.

FURNITURE

Double-Decker Bed, *277A*	.25
End Table, American Empire, *241A*	.25
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Magazine Rack, Ladder-Back Style, *250A*	25
Mirror Frame, 20 by 30 in., *246A*	.25
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Smoking Stand, Modern, *238A*	.25
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Table, Four-Leaf Card, *239A*	.25
Tables, Tile-Top, *249A*	.25
Tavern Table and Scroll Mirror, *105*	.25

BOATS

Camper's Boat, 11 ft. 2 in. long (can be rowed or used with outboard), *281-R*	.50
Canoe, 16-ft. Canvas-Covered Kayak, with sail, etc., *192-193-194-R*	1.00
Duck Boat, Canvas Covered (13 ft. 6 in. long; weighs 60 lb.), *279-R*	.50
Duck Boat, Folding (13-ft.), *170-R*	.50
High-Speed Boat for Small Outboard Motors (7 ft. 11 in. long), *257*	.25
Installing Inboard Motors, *270*	.25
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MISCELLANEOUS and TOYS

Airplane Model, Flying—S.E. 5a World War Plane, 30-in., *168-169*	.50
Hand Loom, Four-Treadle, *268A-269A*	.75
Microscope Kit, Portable, *220*	.25
Perpetual Star Chart, *214*	.25
Projector for Photos and Pictures, *259A*	.25
Toy Birds and Animals, Jig-Sawed, *56*	.25
Toy Drill Press, Lathe, Saw, etc., *113*	.25
Toy Dump Truck, Fire Engine, etc., *101*	.25
Weather Vane, Ship Model Type, *66*	.25

SHIP AND COACH MODELS

(Construction kits are available for some of these models. See page 96)

Clipper Ship *Great Republic* (31½-in. hull), *272-273-274-R*	1.25
Clipper Ship in a Bottle, *121-122*	.50
Coast Guard Patrol Boat (20¾-in.), *286-287*	.50
Constitution (21-in. hull), *57-58-59-R*	1.00
Cruiser *Brooklyn* (8-in.), *236*	.25
Freighter, Ocean (14-in.), *271*	.25
Galleon *Revenge* (25-in.), *206-207-208-209*	1.00
Hartford, Farragut's Flagship (33¾-in. hull), special prints *221-222-R*	1.50
H. M. S. *Bounty* (8½-in. hull), *254*	25
Mayflower (17½-in. hull), *83-84-85-R*	1.00
Motor Boat, Working Model (20-in.), *196*	.25
Nourmahal, power yacht (8⅛-in.), *276*	.25
Liner—*Aquitania* (9-in.), *225*	.25
Liner—*California* (12½-in.), *251*	.25
Liner—*Normandie* (20⅝-in.), *264-265*	.50
Liner—*Queen Mary* (10¼-in.), *283*	.25
Pirate Felucca (20-in.), *44-45-R*	.75
Privateer of 1812—*Swallow*, a Baltimore clipper (13-in. hull), *228-229-230-R*	1.00
Santa Maria (18-in. hull), *74-75-76-R*	1.00
Stagecoach with Horses, *144-145-146-R*	1.00
Steamboat, Mississippi (19¼-in.), *94-95-96-R*	1.00
Trading Schooner (17½-in. hull), *252-253*	.50
Tugboat, Harbor (11¾-in.), *284*	.25
Tugboat, Water-Line (5 3/16-in.) and Barge (7 3/16-in.), *285*	.25
Whaler—*Wanderer* (20½-in.), *151 to 154*	1.00
Yacht *Rainbow* (7½-in. hull), *233*	.25
Yacht (20-in. racing), *48-R*	.50

RADIO SETS

All-Wave Portable (battery), *217-R*	.50
Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50
Five-Tube Short Wave (A.C. or D.C.), *223*	.25
Full Electric Headphone Set, *130*	.25
One Tube (battery operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25

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PHOTO INTENSIFIER AND REDUCER

(Continued from page 74)

for 30 minutes. The success of any method of intensification or reduction, of course, depends upon the film's having been thoroughly washed before the operation.

A safe reducer that will work upon the shadows with the same amount of reduction as the high-lights receive may be mixed as follows

SOLUTION No. 1:

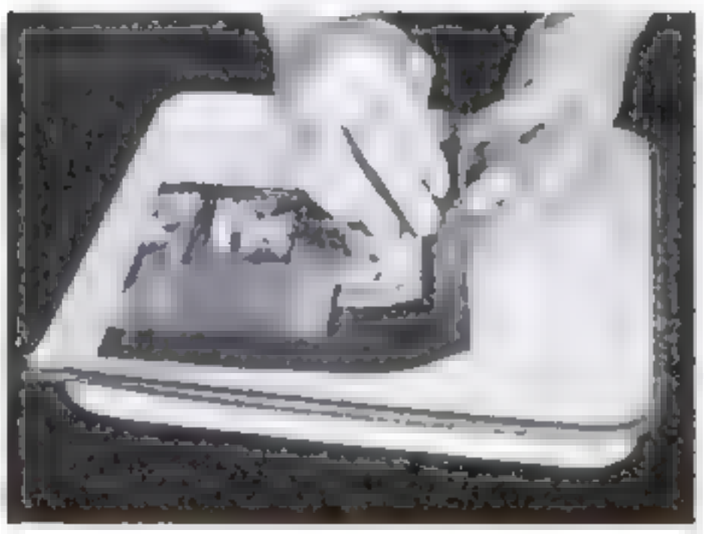
Water	16 ounces
Potassium permanganate	2 grains
10 percent solution of sulphuric acid	¼ ounce

SOLUTION No. 2:

Water	48 ounces
Ammonium persulphate	1½ ounces

For use, take one part of No. 1 to three parts of No. 2. Clear the negative after reduction in a 1 percent solution of sodium bisulphite and wash as usual for about 30 minutes.—IVAN C. LUCKMAN.

TRICKS IN SALVAGING CONTRASTY PRINTS



WHEN a photographic print is so contrasty that it prints satisfactorily over most of its area but a face or hand refuses to register the proper detail, the picture can often be improved by lifting it partly from the developer and placing one finger directly under the light area; then moisten another finger with hot water and place it on the spot to be built up. The added heat will usually speed up the action of the developer at the point so treated sufficiently to save the print.

Prints that cannot be printed and developed by the usual procedure because of the over-all harsh contrasts sometimes respond to the following treatment: Leave the print in the developer only until the shadows register, then remove it and place it face up in a tray of clear water at the same temperature as the developer. Leave the print in the water until no further action can be noted, usually about four minutes. Replace it in the developer and continue the development. The water should be renewed for each print so treated. The action seems to be to retard development in the dark areas while the high-lights continue to develop at a relatively higher rate.

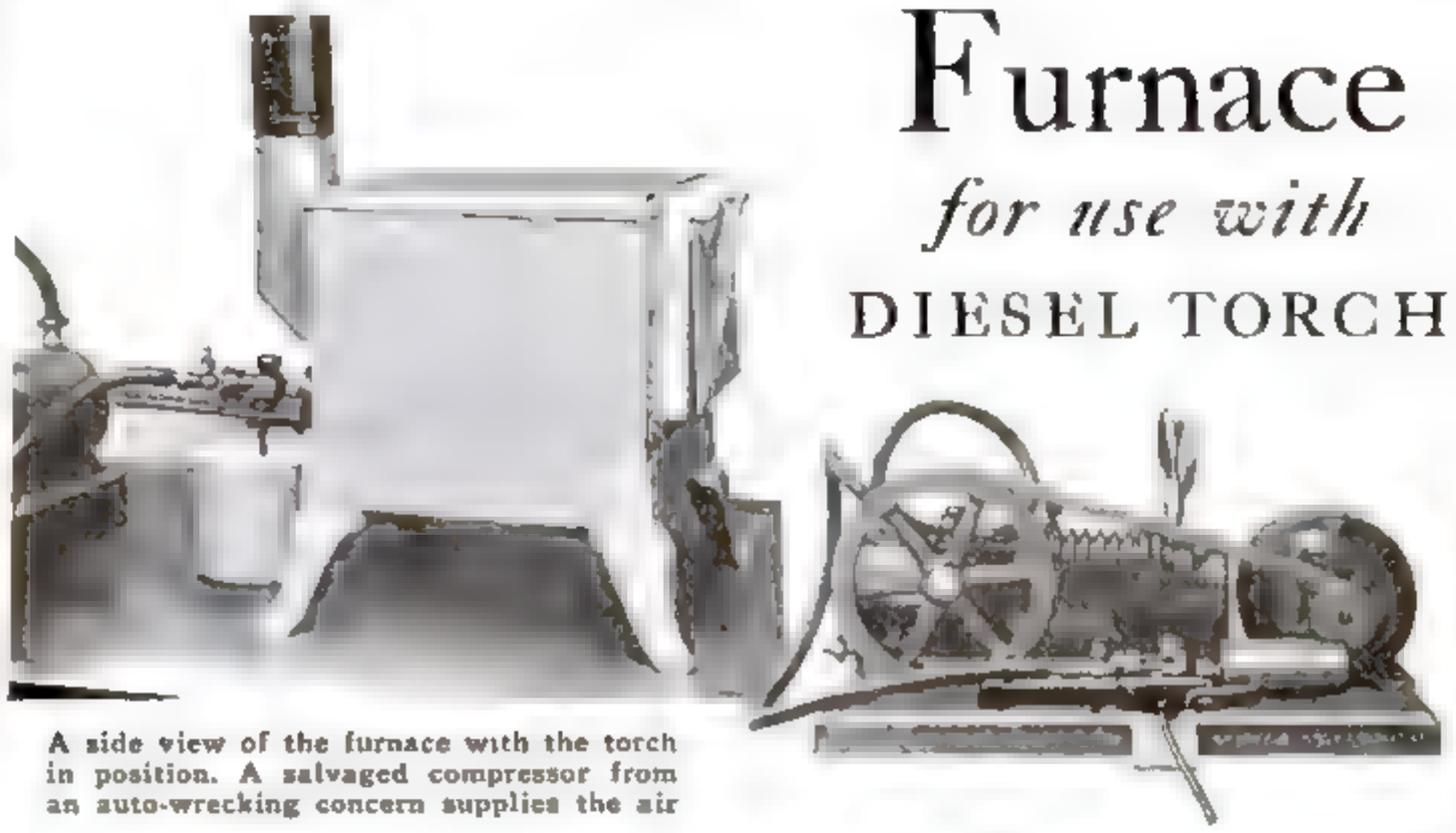
MOUNTING PHOTO PRINTS

(Continued from page 74)

like pillowcases, and fill them with lake sand. Do not stuff them, but rather add sand only until they will lie perfectly flat, so that the sand will be free to follow any slight irregularities in the mount. The sacks should be made from some washable material, preferably white. If you wish to hasten drying, place the sacks in a warm oven for an hour or two until the sand is thoroughly dry, but do not use too hot. Incidentally, one of these sacks, if warmed through and placed under your developing tray, will keep the developer at its most efficient temperature for at least an hour in cold weather.

Tempering *and* Melting Furnace

for use with DIESEL TORCH



A side view of the furnace with the torch in position. A salvaged compressor from an auto-wrecking concern supplies the air

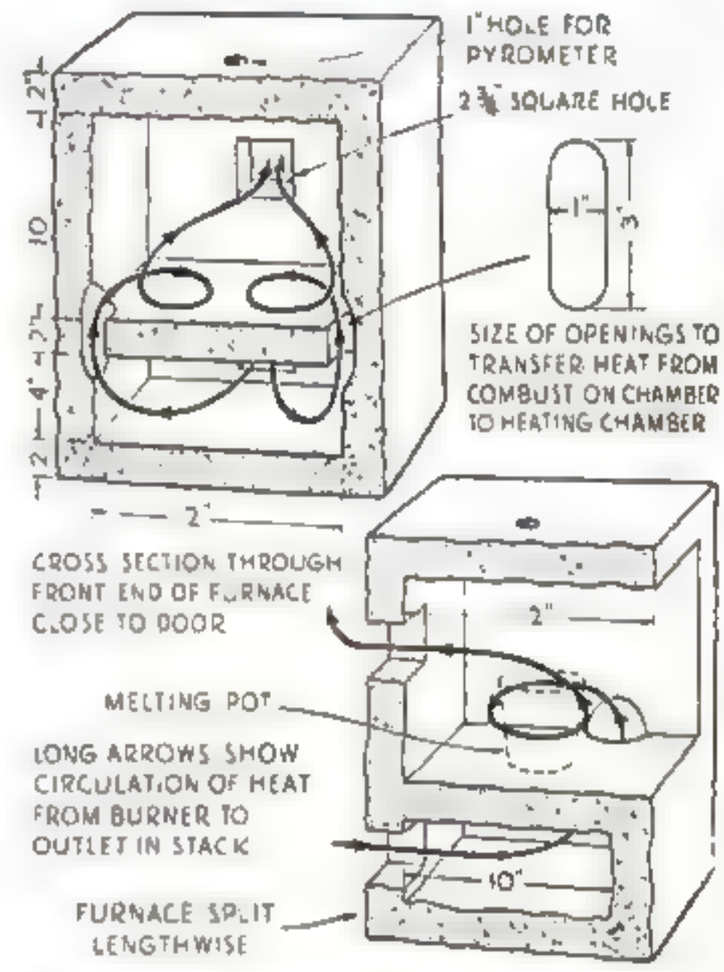
By W. C. CHENEY

A TEMPERING and melting furnace that uses Diesel oil for fuel may be constructed for less than five dollars by following the accompanying illustrations. Although intended primarily as an annealing and tempering furnace, it may be used also for smelting samples of ore and for making small iron, brass, and aluminum castings when used with the air Diesel oil torch described in last month's issue (P.S.M., June '36, p. 84).

Because of the construction, whatever is placed in the furnace is heated by indirect heat, which has obvious advantages. When used with the air Diesel torch, the heating chamber may be adjusted for an oxidizing, carburizing, or neutral heat, all of great use in shopwork.

The dimensions may be changed to suit special conditions, but the furnace shown gives good results for a wide variety of work. A damper may or may not be used, depending upon the type of work, but when the furnace is used for smelting or melting metals, a damper is of considerable value. The door must be faced with fire brick, and all brick joints must be tight, with high-temperature cement between all joints. The fire brick and suitable cement may be obtained from large building material dealers or from furnace repairmen.

The furnace is covered with light sheet iron, and the joints are spot welded. Sheet iron is used also for the stack, being welded and extended into the outlet opening of the furnace.



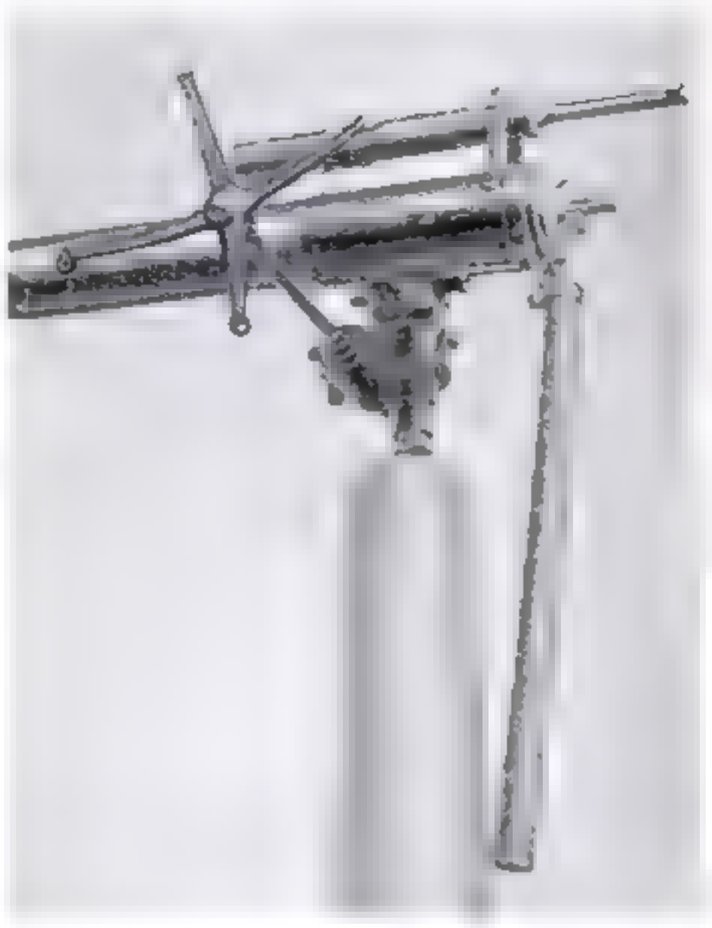
Two cutaway diagrams of the furnace showing method of arranging the slabs of fire brick

The brickwork is made from slabs of fire brick, sawed and filed or ground to fit. The door may be made from a piece of ⅛-in. plate or, as in the one shown, purchased from a local stove works. In either case it must be faced with fire brick. The openings from the combustion chamber to the heating chamber should be placed as shown and in the same proportion for even heat distribution.

If there is no convenient air supply to operate the torch, a small compressor may be rigged up as illustrated at a moderate cost.

Rear of furnace with opening for torch, and, right, view into heating chamber from front

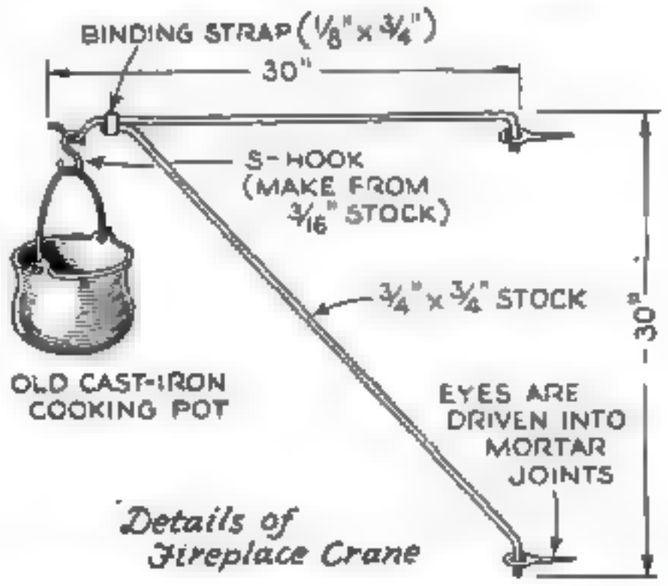
STEERING-GEAR PARTS SUPPORT TELESCOPE



THE mounting of this refractor telescope consists of two worm gears from the steering mechanism of old cars. The two gear housings are welded together so that one turns the telescope while the other raises or lowers it. One unique characteristic of this easily constructed mounting is that it will take either a reflecting or a refracting telescope with slight changes, yet the cost of the necessary parts is very small.—S. JANES.

The worm-gear housings are welded together to give the telescope a universal mounting

CRANE GIVES FIREPLACE AN OLD-TIME LOOK



Details of Fireplace Crane

WHEN you dress up your fireplace with a hammered fire set such as that described in a recent issue (P.S.M., Dec. '35, p. 79), why not go all the way and add a pot crane of the type used by our forefathers for cooking?

Make the top member of 3/4 by 3/4 by 32 in. iron. Heat one end *(Continued on page 89)*

LOW-WING Basic Trainer Model

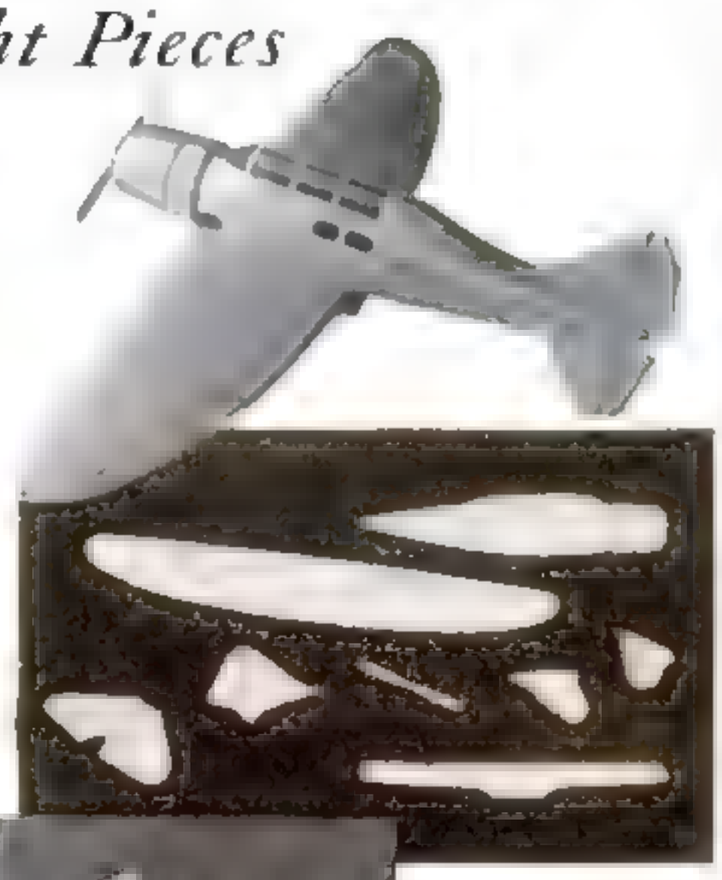
Built from Eight Pieces

By DONALD W. CLARK

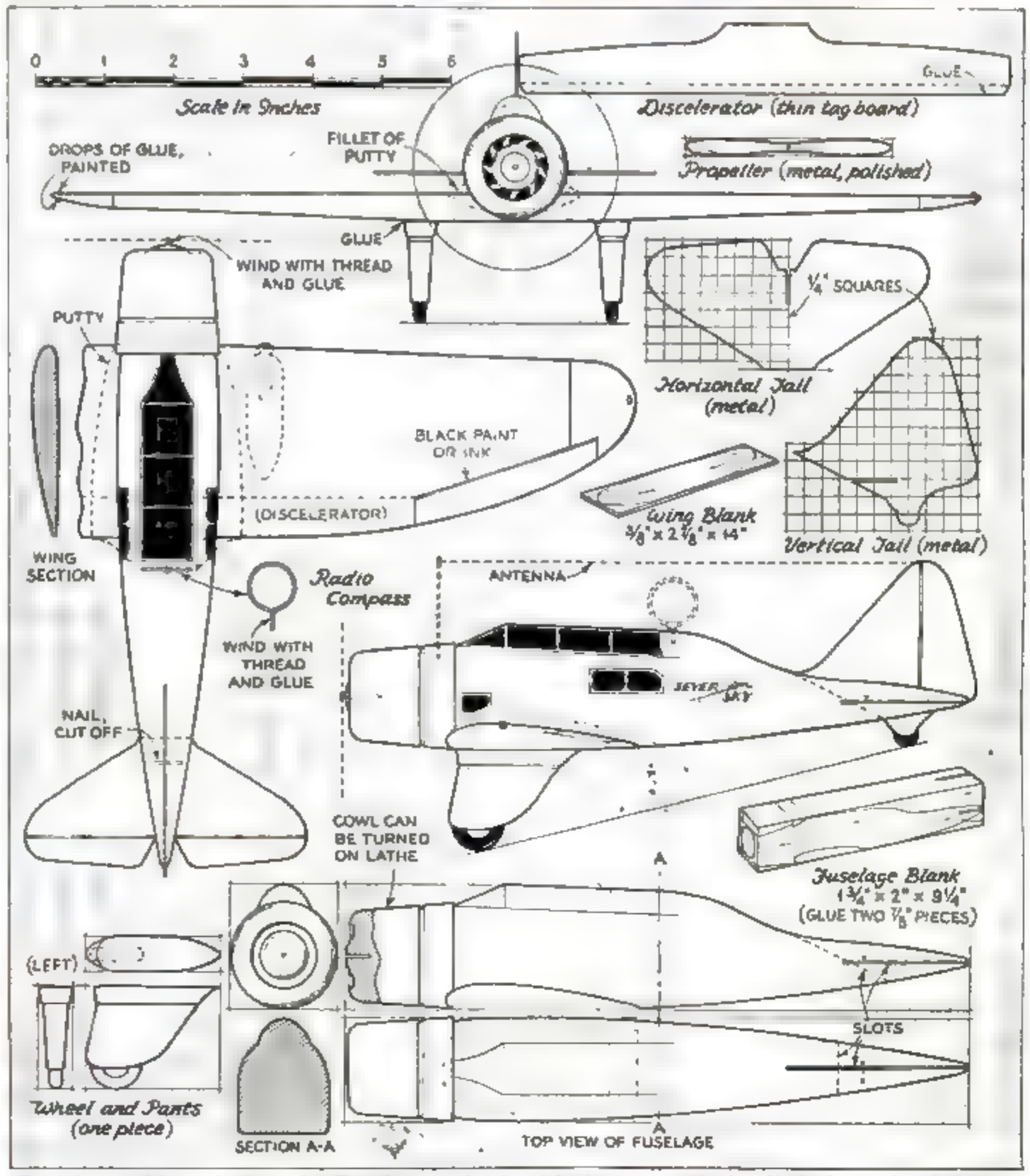
THE Seversky (Sev-3XAR) basic trainer is a low-wing, all-metal monoplane incorporating many modern refinements. More advanced than a primary trainer, the basic trainer is a transition type planned to ease the cadet's progress between the primary and the modern combat planes. On our usual scale of ⅜ in. equals 1 ft., a model of it can be constructed easily with only eight pieces.

The plane's span is 36 ft.; length, 24 ft. 3 in.; and height, 11 ft. 4 in. The wing section is based on the Clark Y, but is modified slightly at the nose and has a reflexed trailing edge. The long trailing edge flap, or "discelerator," as the designers have termed it, is of major interest aerodynamically. It is continuous across the center section.

The entire model is dark gray, except the front of the engine and the window frames, which are light gray, and the tires, trim, and name, which are painted black.



Completed model, the shaped parts ready for assembly, and, at left, applying the dark gray body paint. Stain windows with black ink before painting



Drawings with an inch scale. Fuselage and wing blanks are marked a little large for finishing

CRANE FOR FIREPLACE

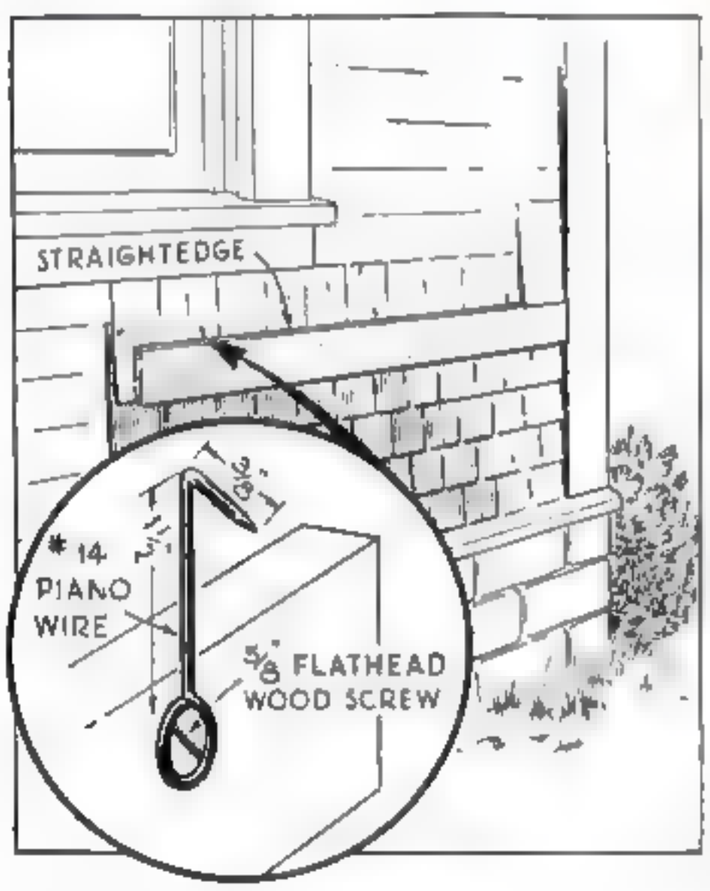
(Continued from page 87)

in the furnace and forge the hook on any heavy scrap of iron that is available. The other end, which enters the eye, is then bent over in a vise. The brace is made of the same stock, but is approximately 43 in. long. The upper end is flattened to about ⅜ in. thick and fastened to the top member by means of an iron strap encircling both. Before assembly, however, both members should be hammered with the ball end of a ball-peen hammer. This can be done on the cold metal, but it is much easier if the metal is heated

The eyes can either be bought and then hammered, or they can be made from ½-in. square stock. They are driven into the mortar joints at the side of the fireplace.

A well-blackened old cast-iron cooking pot can be hung on the crane by means of an S-hook, or the pot may be omitted, if preferred. The crane itself, if sufficiently rough and antique looking, is an appropriate decoration in itself.—A. JOHN.

SHINGLING MADE EASIER BY SPECIAL GUIDE



ANY one can lay shingles evenly and rapidly without the use of chalk and line by making use of a straightedge like that illustrated. It is a board as wide as the distance the shingles are to be exposed to the weather and of any convenient length.

Points made as shown are fastened to the board at intervals (two are sufficient for a short board) so that the straightedge may be held in position by forcing the points into the shingles of the preceding course. The lower edge, of course, is kept flush with the butts of the last row of shingles laid. After the new course has been finished as far as the length of the straightedge, a screw driver is run up under the board and the shingle close to each pointed wire and twisted to raise the board and shingle sufficiently to enable the point to be released.—R. C. DICKEY.

CLEANING GLASS TUBING

HOME chemists or any one who uses glass tubing a good deal and has difficulty in cleaning it will find that pipe cleaners are excellent for the purpose. Take as many cleaners as are needed to fit the tube and push them through. If the tubing is longer than the cleaners, insert them to within about half an inch of their ends; then withdraw them and repeat the operation from the other end of the tube. This also works well on curved and bent glass pipe.—JOHN J. MOSKO.

FOUNDATION OF FURNITURE FINISHING

(Continued from page 64)

pound cut" as it comes from the can in the proportion of one part of pure shellac to four or even five parts of denatured alcohol. Do not use any form of wood alcohol, the fumes of which may easily cause partial or even permanent blindness in the case of susceptible persons. Do not use motor antifreeze alcohols, since they frequently contain kerosene or pyridine, in which case the shellac coatings will never dry hard enough to sand. Such a reduced coating material will practically disappear into the wood, but is sufficient to seal the unsanded stain coat, and when dry and hard will permit stiffened wood, fuzz, or "whiskers" to be cut down fast and clean with a 6/0 finishing garnet paper without graying the finish, since the color has been driven through the "whiskers" by the sealer.

IF VARNISH is to be used, then the best type of so-called "four-hour floor varnish" should be purchased. This should be reduced with turpentine in the proportion of one part of varnish to two parts of turpentine. Like the shellac, this should be applied over the unsanded but well-dried stain coat and completely brushed out. To dry this coating will require from four to six hours at 75 to 80 deg. F.—much longer than shellac, to be sure. Unlike the latter, however, it will not scratch white when the finish schedule is complete and offers a perfect adhesion to subsequent coats of the same stock applied later. Do not use the grades of varnish known as "cabinet rubbing" because they lack the durability and toughness characteristic of properly made floor varnishes; and in the case of good furniture, toughness and durability over a period of years are the most desirable requisites of a fine finish.

For the application of the sealer, long practice has shown that single-thick, varnish-flowing fitch or oxhair brushes are best suited, since their fine but reasonably stiff bristles lay on just the right amount. They are free from certain objections attending the use of the stiffer and longer bristled XXX black china general-purpose brush. Most amateur craftsmen have come to realize that good cabinetwork cannot be turned out with poor tools. Fully as important, then, is the need of the proper type of high-grade brush, well cared for, in the production of a first-class finish.

Study the illustrations for the correct method of holding the brush, with the fingers down to, or even on, the ferrule. On turned work, stroke around the part, slightly bending the bristle tips, and avoid excess strokes that tend to make the coat foam or bubble. A final stroke lengthwise may be made lightly to tip off the work. Keep the room temperature about 75 deg. F.

WHEN either type of undercoater or sealer has been well dried and carefully sanded with a 6/0 garnet finishing paper slightly moistened with water on the paper back, the piece is ready for the operation of filling. The tip-table top illustrated in last month's article has a center of fine, golden-colored satinwood surrounded by ripple-figured walnut; it therefore requires two different colored fillers—golden toned and deep chocolate brown. The correct method of filling the top will now be described.

Fillers perform two fundamental functions: first, to level up the pores with the surrounding surface of the wood; second, to produce a color effect that, when properly applied, tones and clears up the entire piece of furniture.

Fillers must be made on a nonshrinking, transparent, and hard base material, known in the trade and obtainable commercially as "silex." This is essentially quartz, powdered so fine that it will float on water and yet retain its needlelike or crystalline shape. When used as the principal ingredient of filler, it locks itself into the pores and does not shrink loose as did old-fashioned starch fillers.

For those who want to prepare their own filler base and stock fillers, the following should be made up in 5-lb. lots and kept sealed in a tight can until used: 10 oz. boiled linseed oil; 2 oz. floor varnish, 4-hr. type; 2 oz. turpentine Japan drier; 4 oz. pure turps. Stir well and gradually add 5 lb. silex, kneading with the hands or stiff paddle to form a puttylike dough. This is the so-called "natural" or uncolored filler base

FOR birch, cherry, gum, or similar woods, use 6 lb. of this paste per gallon of thinner. For oaks, mahoganies, or walnut, use 12 lb. of paste. For Philippine mahoganies or lauans, ash, chestnut, or similar coarse-grained woods, use 15 or even 18 lb. of paste per gallon of thinner.

The most practical thinner thus far developed consists of one part pure turpentine and two parts standard grade gasoline (no ethyl). The turpentine keeps the oils, varnishes, and driers in liquid condition, while the gasoline forms a cheap thinner, which evaporates fast enough to be practical in use.

Weigh out the paste base, place in a large enough can for mixing, and reduce with the correct amount of thinner. To color the base filler to the golden tone required for satinwood, use French ocher, golden shade, ground in oil and sold in 1-lb. cans. About 1 lb. is required per gallon of completed filler.

For the brown to be used on walnut, use burnt umber with a little Van Dyke brown if a darker shade is needed. Generally 1 lb. of color, ground in oil, will readily color 1 gal. of ready-to-use filler base.

For filling the following are required: an old, stubby brush, well cleaned out; several pieces of clean burlap cut about 12 in. square; some clean rags free of buttons or snaps; and a picking stick made of a ¼ by 6-in. wood dowel sharpened to a pencil point at one end and a flat skew-chisel edge at the other

First, the golden filler is well stirred and brushed on freely over the satinwood center of the table top. Care must be taken not to get any on the walnut. This is allowed to become set or lose its turpentine shine and is then padded in with a piece of clean burlap folded into a pad and used in a circular motion to insure pressing the filler mass into all parts and crevices of the surface. Following this operation, clean rags are used to remove all surplus stock, working *across the grain* constantly. Inspect the work carefully *against the light* to see that all pores have been leveled up.

The brush is now quickly cleaned out in a little gasoline, snapped dry by swinging sharply at arm's length towards the floor, and then dipped into the well-stirred brown filler and applied over the walnut portions. Brush on *with the grain;* let set slightly; pad in vigorously with a circular motion, and clean off *across the grain* before the filler begins to dry or rub hard. Speed in filling is most important.

Clean up the work with a fresh cloth. Run the picking stick around all molding and fillet lines to free them of all traces of left-over filler. Dust off lightly but thoroughly with a round or flat duster, and with a clean pad of cloth remove every trace of finger marks or smudges of filler. Be sure that the entire surface has a clean, even gloss indicating that all pores have been filled level. In case of any deficiency in this respect, refill and reinspect. *(Continued on page 91)*

FURNITURE FINISHING

(Continued from page 90)

Any traces of filler left to harden offer the same resistance to sanding as would a concrete floor. Should any filler be left by accident until it has had time to harden, remove it most carefully with 6/0 garnet finishing paper and gasoline. Great care will be necessary to avoid sanding through the sealer and stain coat. If some portion is sanded too much, a small cloth pad wet with stain must be passed lightly but equally over that part of the surface and allowed to dry.

Set the filled work aside to dry in a room kept at 70 or 75 deg. F. for twenty-four hours. Improperly or insufficiently dried filler coats can cause much trouble during later finishing operations.

In the following and third article of this series, Mr. Waring will tell how to apply finishing coats and give many pointers on brushing practice.

METHODS OF LIGHTING THE MINIATURE STAGE

(Continued from page 67)

doors, by windows and lamps. Hence in a stage setting the light must have a definite direction. While there may be more than one direction, only one should be obvious.

Stripped to essentials, stage lighting is but a multiplication of a single unit—a housed bulb, a dimmer to control its intensity, and a switch. For the marionette theater almost any lamp with a reflector that concentrates the rays will serve for stage lighting.

One type of flood lamp or "olivette," as it is called, is shown in Fig. 1. It is a sturdy, portable, open box affair. The reflector is a small muffin tin, and the lamp is a tiny 15-candle power automobile headlight. Current is supplied through a small transformer.

One of these flood lamps is used on each side of the proscenium opening, plugged in an outlet at the side of the stage floor. The standards are made of sheet metal (galvanized iron). A strip 1½ in. wide is doubled over to form a slot into which a slightly narrower strip is telescoped on the principle of an adjustable brass curtain rod; in fact, such a rod might be used. A 3-in. disk of lead ⅜ in. thick forms the base to which the strips are secured. All parts are painted dull black with the exception of the inside of the muffin tin, which is the reflecting surface.

Colored gelatin screens can be slipped in back of the crossed wires shown in Fig. 1. These colored screens are fairly durable and quite inexpensive.

THE flood light and the spotlight are often used together, the latter to light the center of stage, the former to give a sort of half light for atmosphere. These lamps may be standing or they may be clamped to bars above the stage or at the side. Such portable lamps are sufficient on our small stages. The bulbs can be permanently fixed as in Fig. 2, if desired.

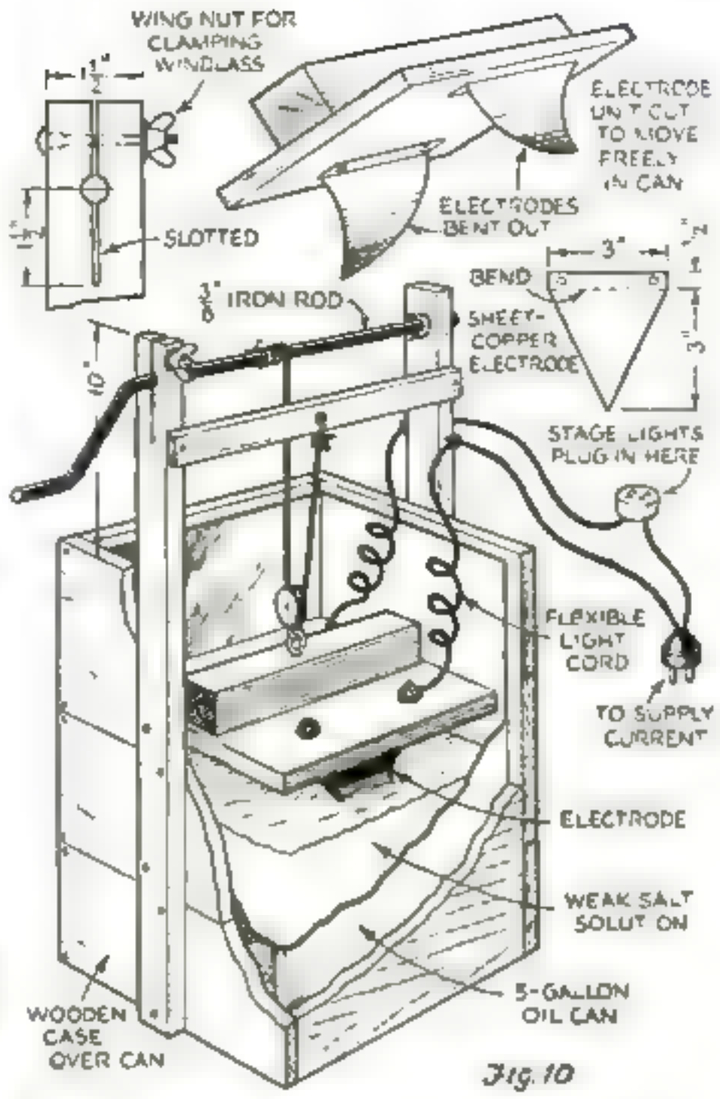
An effective set of footlights (Fig. 3) can be made by bending a strip of tin about a long block of wood to form a trough in which to set small electric lamps, or a string of Christmas-tree lights may be used satisfactorily.

Spotlights and flood lights can be constructed from discarded tin cans. It is advisable to make several of these, using a can large enough to hold a 40- or 60-watt lamp when the lid is placed on. With an ordinary can opener cut a square hole in the lid of the can (Fig. 4). Stretch several elastic bands over the lid before it is replaced; they are used for holding the gelatin screens.

The socket, if *(Continued on page 92)*

LIGHTING THE MINIATURE STAGE

(Continued from page 91)



Homemade light dimmer for marionette stage

metal, must be covered with tape to prevent a short circuit. Push the socket through the hole in the can and screw a lamp into the socket, thus preventing it from slipping out of place. A block of wood nailed to the side of the can will keep it from rolling and hold it to the stage floor (Fig. 5). For ventilation a few holes should be punched in the bottom.

Lights of this type may be hung from different parts of the stage if wires are attached to the cans.

Another kind of light is shown in Figs. 6 and 7, made from a pound coffee tin from which the printing has been removed. A hole is cut in the lid, a yoke and a porcelain socket attached, and you have a spotlight. Remove the lid, and you have a flood. The socket, having a piece of friction tape put over the screws to prevent a short circuit, is fitted tightly into one side, leaving the base outside. This raises the bulb so that the light is directly in line with the opening in the lid. A 50-watt clear lamp of the P-19 type is used. It is the same size and shape as an ordinary 25-watt frosted bulb. Paint the inside of the can and lid with a good, heat-resisting flat black (such as black ground in Japan drier) with the exception of the back end, which serves as a reflector. Color slides are slipped into horizontal grooves as indicated.

Figure 8 shows another type made to stand on the stage floor. Sheet tin and wood are used in its construction. The toppiece of wood should be covered with tin to avoid scorching.

Individual lamps are generally better than footlights and borders except occasionally when it may be necessary to light a sky cloth evenly for a ground row.

The primary colors of lighting are red, yellow, and green. By combining these in the right proportions, any color light can be produced. This applies to light, not to pigment colors.

Colored lights may be produced by lamps, the bulbs of which have been dipped into colored dyes, or by silk or gelatin screens. The latter today is the more popular method. The screens are easily made by cutting frames of cardboard just large enough to cover the opening in the spot or flood. Two frames are needed for each color, between which a square from a sheet of gelatin of the desired color is put; paper clips hold all together. Electric bulbs of 25 or 40 watts may also be coated directly with dyes sold for the purpose. The lighted bulb is dipped in the liquid and left alight until the dye coat has thoroughly dried.

Color lighting may take several hours of experimenting for a single scene. Ask yourself if the scene takes place outdoors or in, also the time of day and season of year. For outdoor effects use yellow, amber, and white light with an occasional red or blue. The glow of sunset is more colorful and interesting than the garish light of noon. For indoors in a simple cottage or a medieval interior, the lighting should be soft to suggest candles or torches: yellow and blue overhead with red, blue, white, and amber in footlights. A gay scene needs bright lighting. Fireplaces call for a warm light.

MYSTERY is suggested by blue and violet lights. An interesting effect is a dark tree that in fancy turns into a white ghost or into a silvery fairy. This may be achieved easily by using two slides, one with the gaunt tree, one with the figure, and slipping these, one after the other, in front of the lamp that floods the light background.

If in a dance you wish large grotesque shadows on the background, use only footlights. These may, if used with discretion, give effects of charm and mystery.

In modern interiors table lamps and wall-bracket lights are often needed. Tiny Christmas tree bulbs may be connected and used under shades made as suggested in Fig. 9. Note the suction cup on the wall to hold the lantern. These may be had for five cents each.

A homemade dimmer, shown in Fig. 10, may be built from a 5-gal. oil can, two pieces of sheet metal, an iron bar, and odd bits of wood. The top is cut from the oil can and a wood base built to set it in. Two wood uprights support a light windlass to raise and lower the electrode unit. By means of a thumb nut the windlass can be clamped in any position. A pulley is used to permit finer adjustment than if the windlass cord were tied directly to the electrode unit.

The two electrodes taper down from the top, and the ends are bent out from the center, so that as they are lowered into the weak salt solution more surface is afforded for conductance at a gradually decreasing distance, thus increasing the current. The best method to obtain the solution is to start with plain water and keep adding table salt a very little at a time until the desired effect is obtained.

For information on the construction of puppets and marionette theaters, see the previous articles in this series. The subjects covered were puppet heads, P.S.M., Jan. '36, p. 57; marionette bodies, Feb., p. 64; marionette stages, Mar., p. 64; stage sets and scenery, Apr., p. 71; and stage properties, May, p. 70. In two earlier articles Mrs. Drake told how to make marionettes from old inner tubes (P.S.M., Sept. '35, p. 58, and Dec. '35, p. 67).

Wanted... from Model Railway Fans

short articles, hints, and suggestions of interest to all those who have a miniature railroad system or intend to build one. Each item should be illustrated with one or two clear photos and, if necessary, a pencil sketch. The text should not exceed 200 words. Payment will be made upon acceptance for all available material.

EASY WAY TO LAY OUT AN ACCURATE SUNDIAL

(Continued from page 70)

paper, transfer this drawing to a piece of wood ⅛ in. thick. Saw this out, glue ⅛-in. square strips around the edge, and fasten on the decoration, made of thin wood. These strips and the decorations should be glued on both sides of the gnomon. Round all corners with wax, sandpaper the wood, and finish with two or three coats of shellac.

Both patterns are now ready for the foundry. The cost of brass castings the size of these is very reasonable. Go to the foundry yourself, if possible, and get the castings as they are removed from the sand. Clean them with a wire brush, grind or file off any marks, and polish all high spots with an abrasive stone.

The gnomon is attached to the dial face with two machine screws. Two holes also should be drilled in the face for wood screws to be used later for attaching the dial to the pedestal.

The construction of a homemade three-piece pedestal is shown in the photographs and in Fig. 2. The upper and lower parts are identical, except that the upper section has a block of wood cast in it for holding the two wood screws used to fasten dial and pedestal together. Both the upper and lower sections are made with a 4-in. square stub on them. The stem or middle part has a 4⅛-in. square hole in it for the stubs to fit into. The molds for the concrete are simple boxlike forms. A good, strong mixture of cement and sand should be used.

The completed dial should not, of course, be placed where a tree or building will cast a shadow upon it. It must be set so that twelve o'clock is pointing absolutely north. The dial must be level, and the gnomon should not incline to either the left or right. On April 15, June 15, September 1, or December 24, turn your dial so that it agrees with any good watch, and you may then be sure your dial is pointing north.

TURNED WORK COLORED WITH SEALING WAX

MANUFACTURERS of art objects in India sometimes produce a pleasing finish on turned articles by applying thin coats of sealing wax of appropriate colors. This has been termed "lac finishing."

Finish the article by sanding, after turning operations have been completed; then hold sealing wax against the parts to be colored and operate the lathe at high speed. Friction between the wax and the wood will melt the former, causing it to flow out in a thin layer. Often this layer is irregular, but it can be smoothed out by holding a cloth pad against the surface until the coating becomes plastic. Use as small a cloth as practicable and be careful not to let it wrap around the work, as it is inclined to do, sometimes with considerable violence. No other finishing is required.—W. E. B.

SCALE MODEL OF COAST GUARD PATROL BOAT

(Continued from page 57)

latter case the blades are twisted to shape, and the boss and back of the blades are built up with plastic material. The bearing on the sternpost is a piece of tube soldered to it.

The strut is another piece of sheet metal bent to give a flattened, half-round effect, with the end bent around the shaft tube and there soldered. The end of the tube goes into the hull at the position shown, and the boss is built up with plastic material.

When it comes to painting, note that the water line is not level with the keel but is 11/16 in. high at the bow and 1 in. at the stern. Below this line is a ¼-in. black boot-topping stripe; below that is red oxide (which can be represented by Indian red artist's oil color), and above is a light gray made of black and white with a touch of blue to give it life. All above the boot-topping is light gray except the funnel tops, which are black; the ladders, teak color; the life buoys, white; and the running lights, red and green. The decks are a darker gray than the hull.

The deck house can be a solid block of wood cut to the given dimensions, with air ports as on the hull and a door on either side, indicated with V-cuts. I found the easiest way to make the deck and protecting screen on it was to use thin metal (brass or tin) cut to the shape shown in the plan.

Bend the projecting pieces sharply up at the dotted lines and solder their edges together. Also solder the two separate oblong pieces in the gaps on the after side of this bridge. The bridge does not come to the fore edge of the block, *(Continued on page 95)*

List of Materials

No. of Pieces	T	W.	L.	For
5	7/16	3 ¼	20 ¼	Hull
2	1/16	1	22	Bulwarks
4	1/16	1/16	22	Moldings
1	¼	¼	7	Skeg
1	⅜	2-1/16	4	Deck house
1	⅞	1-9/16	1-5/16	Pilot house
1	⅜	⅜	2	Companion (1) (4)
1	⅞	⅝	½	Companion (1)
1	7/16	1 ⅜	3 ⅝	Engine casings (2)
1	7/16	⅞	10	Boats (4)
1	¾ round		2½	Funnels (2)

NOTE: All this material may be white pine or other softwood. The funnels, however, may be made of metal, if preferred. Use scraps of softwood for the deck fittings not mentioned. All dimensions in the list are given in inches.

MISCELLANEOUS

1 pc. hardwood ⅛ in. round and 12 in. long for masts and flagpoles.
1 pc. sheet metal 3¼ by 7 in. for house decks, etc.
2 pc. brass rod 3/32 in. round and 2 in. long for shafts.
2 pc. brass tubing 3/32 in. inside diameter and 4 in. long for shaft tubes.
2 ventilators, 1 bell, 1 whistle, and 2 anchors.
4 in. of chain, 14 links to the inch.
4 davits, 1¼-in. with blocks and sockets.
4 life buoys, 5 16 in.
6 pair ⅝-in. butts.
2 propellers, ⅝-in., right and left; 3-blade
4 in. of No. 18 soft wire for vents, etc, and 4 in. of No. 18 stiff wire for antenna stretchers.
9 in. of No. 24 wire for ladders.
22 ft. of fine wire (about No. 34).
9 glass beads.
Stanchions: 24, 2-ball, ⅜-in.: 26, 1-ball, ⅜-in., 32, 3-ball, ⅜-in., 20, 2-ball, ½-in.
Small pieces of thin cardboard.
Flags as shown on drawings
Black, white, blue, and Indian red paint.
Glue, nails, etc.

SCALE MODEL OF COAST GUARD PATROL BOAT

(Continued from page 94)

but projects beyond it abaft. This after piece has its edges bent down to represent angle irons; and into the corners thus formed are soldered angle-iron stanchions, which are driven into the deck below. Cement and a few nails will hold this structure in position.

The pilot house is a similar block of wood with the windows and doors carved in the wood, or they may be cut out of a cardboard overlay, which is then glued on. The window frames and doors are teak color, the rest gray. This piece should be nailed through to the piece below. The deck on the pilot house is made like the one below, but the front edges are bent slightly down to shoot the water away from the windows.

BOTH these decks have handrails with two-ball, 3/8-in. stanchions. Those stanchions that stand on projecting parts should be soldered in position before placing the decks; the others can go through the wood.

On the top deck are three searchlights. These I made from round wood, hollowed, lined with tinfoil, and faced with celluloid. The sustaining arms are strips of brass soldered together below the lights, with a pin right through all. The radio compass is filed from wood. There are two arms with square ends, joined by two round pieces and set in a support. The standard compass binnacle is turned or filed from a piece of brass rod. I left it bright brass, but believe it should be gray.

For the running lights, I bent up angles of brass, 1/8 by 3/8 in., and set colored beads in plastic material to represent the lanterns. They are soldered to the pilot-house deck, outside the rails. The whistle is filed from brass.

On the lower deck there is a flag locker and emergency generator, which are just blocks of wood. There are two life rafts, one on the other. These are oval in plan and round in section, with battens glued under them and grab lines tied to them. The latter are heavy thread tied in position with thin thread.

For the antenna lead-in, I made little tubes of fine wire mesh taken from an old radio tube, and drilled holes through the deck into the wood to hold them.

The ventilator sets can be seen in the detail drawings and deck plan. They are pieces of wood cut to shape and have air trunks leading down the sides of the deck house.

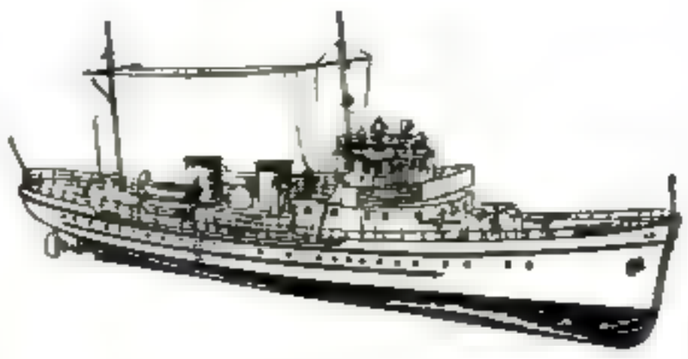
THE life buoys at the bridge ends are turned from bone, celluloid, or wood. They are held in position by triangular pieces of metal soldered at the middle to the screen and bent up and over. The teakwood ladders are made in the usual manner and glued in position, with wire handrails to the outside stanchions.

The engine room casings (which would be called "fiddleys" in the merchant service) are oblong blocks with rounded corners. On the forward one there are four sets of two deadlights (deck lights) and four of three lights. These are supposed to rise on hinges. I made each of them of two pieces of thin cardboard, one having the required number of holes punched in it and glued down over the other. There are also two ventilators and a companion hatch abaft. The after casing is much smaller and has only two sets of deadlights.

The funnels go on the two casings and may be made of sheet metal or tubing, but wood serves the purpose very well. There should be rims at the top edges. Two or three layers of paper glued on will do if the funnels are of wood, but a metal strip must be soldered on if they are of metal. On the foresides you can set rod ladders. Each funnel has four guys leading to eyebolts on the casing. They are black 3/16 in. down, and the rest is gray.

Next month we shall complete the model.

NEW KIT FOR COAST GUARD BOAT MODEL



KIT 5S—All necessary raw materials and full-size blueprints for building our new 20⅝-in. long model of a Coast Guard boat

FOR the convenience of readers who wish to build our new scale model of a 165-ft. Coast Guard patrol boat, a special construction kit has been prepared containing all the necessary materials and a set of full-size blueprints. It is marked 5S in the following list.

The new model is designed to be built on the scale of ⅛ in. equals 1 ft. This makes the hull 20⅝ in. long.

The kit contains the five hull layers or "lifts" cut carefully to shape and ready for gluing; all necessary wood strips of the required thicknesses for bulwarks, moldings, and similar parts; two die-cast propellers, one right-hand and the other left-hand, with the necessary shafts and tubes; sheet brass for deck fittings; two anchors, six bitts, two ventilators, four life rings, a brass bell, brass ladders, and chain; three hand-painted silk flags; a porthole tool; an assortment of wire, beads, nails, and pins to be used for stanchions and other purposes; and gray, black, and Indian red paints. Ample raw materials (except glue) are included for making a high-grade, full-hull model and, of course, a good deal more than is necessary for constructing either a water-line model or a half model.

KIT A—Materials for model of whaler

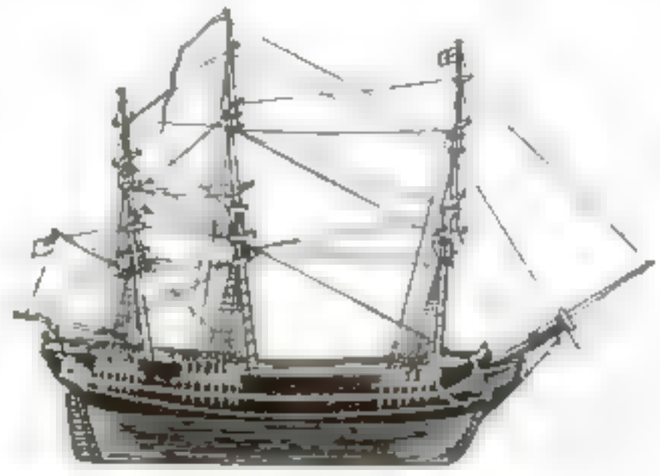
This assortment of materials, like all our standard ship model kits, is entirely different from the commercial kits commonly sold in stores. An experienced model maker has selected the materials, cut out the hull parts and strips, and put everything together in a convenient package, just as you would have to do yourself if you bought your own raw materials. The advantage is that in this way you can save the time required to shop around for a number of more or less hard-to-get materials and also prevent the waste that results from having to buy larger quantities than are needed. You can put all your time into the actual construction of the model, which is, of course, by far the most interesting and profitable part of the work.

If you prefer to build a smaller and less elaborate model, try one of our simplified ship model kits or one of the special kits designed for the Model-of-the-Month Club.

All our kits that are still available are given in this list. Each kit is accompanied by the necessary blueprints or instructions:

STANDARD SHIP MODEL KITS

A. Whaling ship *Wanderer*, 20½-in.....$7.40*
D. Spanish galleon, 24-in..... 6.95*
E. Battleship U.S.S. *Texas*, 3-ft..... 7.45*
G. Elizabethan galleon *Revenge*, 25-in. 7.25*
L. Farragut's flagship *Hartford*, steam-and-sail sloop-of-war, 33½-in. hull ... 8.45*
Q. Privateer *Swallow*, 12½-in. hull .. 4.95†
V. Clipper *Sovereign of the Seas*, 20½-in. hull ..... 4.95†
Y. Trading schooner, 17½-in. hull..... 4.90†
2S. U. S. Destroyer *Preston*, 31½-in. hull 5.95*
3S. *Constitution* ("Old Ironsides"), 21-in. hull 6.50*
4S. Clipper ship *Great Republic*, 31½-in. hull 8.40*
5S. Coast Guard patrol boat of new 165-ft. class. Full-hull model, ⅛-in. scale, the hull being 20⅝ in. long..... 4.95*



KIT Z—Materials for H.M.S. *Bounty*

SIMPLIFIED SHIP MODEL KITS

F. Liner S.S. *Manhattan*, 12-in..... 1.00
H. Cruiser U.S.S. *Indianapolis*, 12-in. 1.50
J. Clipper ship *Sea Witch*, 13-in..... 1.50

MODEL-OF-THE-MONTH KITS

M. Aircraft carrier *Saratoga*, 18-in. ... 1.00
N. Four U.S. destroyers, each 6¼-in. .75
O. Liner S.S. *St. Louis*, 11-in..... 1.00
R. U. S. cruiser *Tuscaloosa*, 11¾-in... 1.00
U. *Hispaniola*, the ship in "Treasure Island," 7-in. ..... .50
Z. H.M.S. *Bounty*, 11¼-in..... 1.50
1M. Show boat, illuminated, 14-in..... 1.50
2M. Ocean freighter, 14-in..... 1.50
3M. Yacht *Nourmahal*, 8⅛-in..... 1.00

MISCELLANEOUS

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble, with finishes..... 5.30*

No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¾ in. high. Ready to assemble and stain included..... 5.75*

No. 7. Whittling kit with two shaped blocks for making sea captain 5½ in. high. A knife, three bottles of paint, pocket sharpening stone, and instructions are included..... 1.50

No. 8. Whittling kit for six different Scotties. Each is 2 by 2¾ in., sawed to shape. Paint, paintbrush, instructions, etc..... 1.00

NOTE: If you live west of the Mississippi River or in Canada, add 50 cents to all prices marked with an asterisk (*) and 25 cents to all prices marked with a dagger (†).

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HEIRLOOM CHESTS AND HOW TO BUILD THEM

(Continued from page 61)

Beveling the legs of the paneled chest. If a jointer is not available, use hand tools

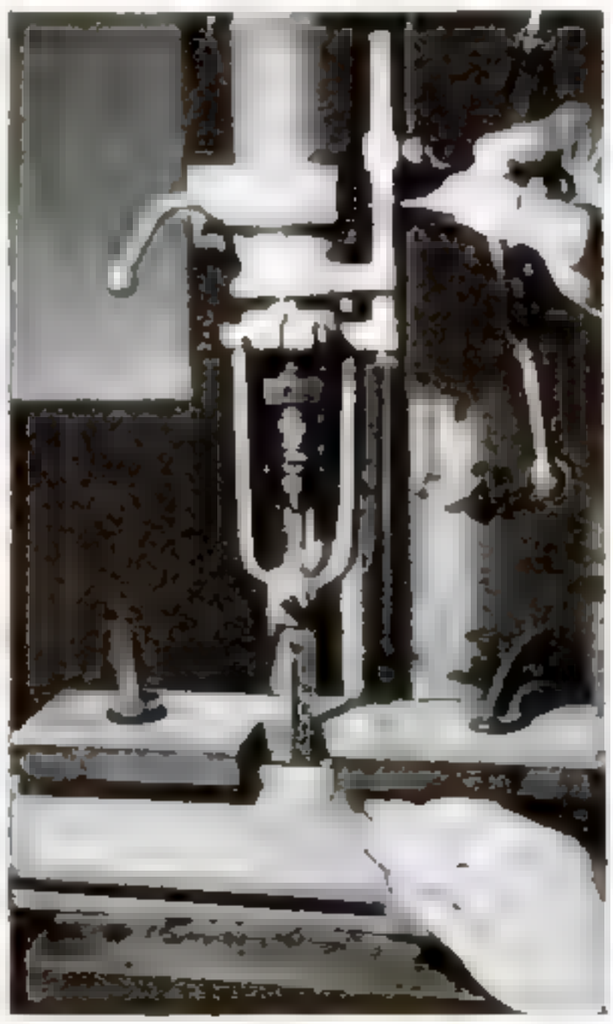
main plan view. This frame is notched at the front corners to hide the joint it makes with the ends of the chest.

The back of the gallery rests on the surface of the top, while the ends of the gallery are glued to the edges of the top. The top is then molded on the shaper after assembling. The base is also assembled before the molding is cut on its upper edges.

If a dado head is available, two cuts on the drawer front and one on the drawer sides will make the joint by means of which the drawer sides are fastened to the front. It may be done on the circular saw by making more cuts. For a particularly fine job, the sides may be dovetailed to the fronts. The drawer fronts may also be veneered if desired.

The correct type of hardware for this chest is shown, though many patterns may be had in the oval plates. The craftsman should purchase brass pulls which have been finished to a dull, aged-looking color.

Colonial Chest. This design is a great deal simpler than the paneled chest. After the boards have been glued up, grooves are cut on the sides and tongues on the ends. Note that an additional inch or so should be added to the length of the sides, as shown in the plan, to prevent the joint from breaking or cracking when the chest is being assembled. This is a necessary *(Continued on page 98)*



The legs are then mortised by hand or with some type of power-driven mortiser

HEIRLOOM CHESTS AND HOW TO BUILD THEM

(Continued from page 97)

precaution, for cedar is very brittle. If the joint is snug, as it should be, the slightest pressure will split the wood at the joint unless this precaution is taken. The extension may be sawed off after the clamps have been removed, and the joint planed and sanded smooth.

The bracket feet are mitered, glued, and bradded at the corners. They are joined to

The rails and stiles for the paneled chest are tenoned quickly by using the dado saw

the chest by screwing the corner blocks, by means of which they are braced, to the floor of the chest.

A chest of this type may be quickly made if one has a circular saw with which to cut the tongues and grooves, and a jointer to plane the boards and straighten the edges for gluing.

VARNISH FINISH BEST FOR CEDAR CHESTS

ALTHOUGH many craftsmen are under the impression that Virginia red cedar should be stained, the reverse is true: it should not be stained at all. The color contrast between the raw sap and the deep colored heartwood is beautiful and there is no point in using a stain.

The following steps should be followed in finishing:

1. Fill all chipped or broken-knot portions with stick shellac of matching color. Apply this either with a knife and alcohol lamp or with an electric soldering iron of small size. Cut off the surplus shellac with a sharp chisel, and sand it clean and level.

2. Seal the entire outside of the case with a good grade of four-hour floor varnish reduced with two parts of pure turpentine to one part of floor varnish. Let dry twenty-four hours in a warm room.

3. Putty glaze with matched putties and a flexible putty knife all portions of torn-out or chipped grain not treated under step No. 1. Dry overnight and sand with a felt block and No. 4/0 paper, or by hand without a block.

4. Revarnish with full-body varnish, brushed out carefully. Dry forty-eight hours in a warm room

5. Sand with a 6/0 paper and revarnish. Dry forty-eight hours in a warm room.

6. Rub with FFF pumice stone, felt pad, and crude oil. If the latter is supplied in too heavy a body, reduce with gasoline to a water-thin body. Clean with dry cloth.—R. G. W.

LATHE AIDS IN BORING HOLES EDGEWISE THROUGH BOARDS

BORING long holes edgewise through boards where there is little leeway presents a problem, but it can be overcome as follows: First drill the holes between lathe centers with a twist drill the diameter of the screw of the bit, going halfway through from each side. This lines up the holes properly. The bit can then be put in the lathe and the holes bored without splitting the wood because the small holes act as guides and prevent the bit drawing in too rapidly.—CHARLES E. EVERINGHAM.

SLIDING CANOE SEAT AND LEEBOARDS

(Continued from page 72)

running across the canoe and clamped to the wales, is used. If the thwart is made to accommodate a sliding seat, the canoeist will be able to get his weight well out over the windward side to ballast the canoe. Extra long clamps rigged to hold the thwart in position distribute the strain over a larger section on the wale.

RAILS, end blocks, cleats, and seat may be made of spruce, if weight is a consideration; but for the rails, beading, and seat, some wood that will not wear so readily is to be preferred, such as ash, oak, or maple. The beading is glued and nailed to the outer edges of the rails as shown with 6-penny finishing nails set at 3 in. intervals in carefully drilled holes, the heads being driven below the surface and covered with plastic composition wood, putty, or plugs before finishing. Trim away both edges of the working face of the rails with a sharp chisel, rounding the face to reduce the friction surface, and sand to a smooth surface.

The end blocks should be carefully squared on the sides and outer ends and must be exactly the same width in order that the seat may run perfectly.

Drive a fine finishing nail just through the end of each rail. Coat the rails and the sides of the end blocks with waterproof casein glue, and lay the pieces out on a smooth surface for assembly. Tap the nails in a bit and test with a large square before driving the nails in until only the heads project slightly. Drive four more nails, test with the square again and, if satisfactory, drive all eight nails home and set the heads. Now fasten the joints more securely with carefully spaced 2-in. flathead brass screws, four screws to each end of each rail.

The mortises for the hooks and angles should be a hair-line fit. Note that the hook must project enough to allow the ½-in. end of the leeboard to fit between it and the face of the end block and that it will be necessary to set the angle back into the block to form a perfect full-face bearing between board, end block, and angle, thus holding the board at right angles to the line formed by the rails. Once the mortises are correct, drill five holes through each hook and end block, and drill and tap the angle to receive bolts, as indicated in the side view.

IF ONE clamp bolt is to be used at each end of the seat, a hole must be drilled right through the end block and angle, and the head of the clamp bolt sunk enough to allow the hook to be placed over it. Where a clamping cleat is used, the holes for the bolts should be drilled at each side of the angle, the heads being dropped just enough to clear the sliding seat. In either case the bolts must be located sufficiently far from the inner face of the angle to make room for the wale and side of the canoe, as well as for some slight adjustment fore and aft to secure a balance between boards and sail pressure.

The clamping cleat should be about 16 in. long by ¾ in. by a maximum of 2 in., tapering to 1 in. at either end. Just opposite the angle, the cleat is fitted with a stiff metal plate that projects upward and meets the underside of the end block as shown in the side view. The upper face of the cleat meets the underside of the wale, distributing strains from the leeboards and sliding seat over a longer section of the hull.

The metal center strap need not be of particularly heavy metal, but the angles should be sharply turned. It should fit the surface of the seat closely. Bore and countersink each end for four screws just long enough to miss showing inside the rails.

The seat should be made of 1-in. stock, which, if routed as indicated by the dark markings in the sketch, will be light enough without being unduly weakened. Lay it between the beadings and work to a smooth running fit. Pencil mark the sides of the seat just above the beadings and round the top to the markings. Stops of hardwood are screwed to the ends to prevent the seat from running out from under the center strap.

Finish the board as described for the leeboards, but put no varnish along the working edges of the seat nor upon the upper faces of the rails. These parts are given a thorough rubbing with beeswax and paraffin.

Bending the heavy brass angles is quite a job unless done in the right manner as they must be a full 4 in. wide by 10½ in. long by ⅛ in. thick. Four inches of the length is bent to a right angle to fit the underside of the end block. Place the short end in the vise and clamp a 2- or 3-ft. board to the projecting end. With this leverage force the bend as desired. The hooks, being of lighter material, are not so difficult to bend. It is best to bore the pivot bolt holes in the angles after the angles are in place on the thwart.

The pivot bolts should be ⅜ in. in diameter and barely long enough to project through angle, board, and wing nut—approximately 1⅜ in. The heads of these bolts should be filed away until only about 3/16 in. thick and carefully smoothed and rounded. Large washers placed beneath the wing nuts increase the bracing effect and lessen the chance of splitting the board.

FILTERED DEVELOPERS GIVE BETTER PHOTOS

PINHOLES and ghost-like streaks on photographic negatives and prints, assuming properly mixed solutions, are almost always the result of unfiltered baths. Wise amateurs and professionals filter all their solutions except those that contain pyro. The ardent miniature worker even filters his hypo each time before he uses it. Improper filtering, however, can slow up a developer because it exposes it for a comparatively long period to the air and allows it to become so oxidized that its action is at least erratic.

A good method is to fill a rather small-necked bottle with the freshly mixed solution and cover its neck with a pad consisting of a layer of cotton and one thickness of clean cloth. Hold this in place with a rubber band. Turn the bottle upside down over another bottle with a larger neck, and the filtering will proceed with no further attention and minimum exposure to the air.

If you prefer filter paper, use it in place of the cotton, but retain the covering cloth so that the weight of the solution in the upper bottle will not rupture the paper.

LOCK NUT FOR PIPE OR CONDUIT IMPROVISED FROM A COUPLING

WHEN a lock nut cannot readily be obtained for use on pipe or conduit, saw off a section of a coupling of the correct pipe size and use it instead.—LOUIS N. GOODMAN.

NATIONAL HOMEWORKSHOP GUILD CLUBS

(Continued from page 65)

of W. W. Cranford and under his supervision constructed a number of folding deck chairs. The meeting also served as a demonstration of a coöperative club project on a line-production basis. Ten extra chairs were made for members wishing to purchase them at cost. All metal work was finished and woodwork about eighty-five percent completed in two hours and forty-five minutes.

Mount Vernon (N. Y.) Homecrafters Club. George Hermann has been elected president; Major James D. Kent, vice-president; Joseph Dickman, secretary; Fred Schall, treasurer; Fred Proreck, librarian. The club is conducting a drive for new members, and an exhibition will be held in June. The Recreation Commission has granted the club permission to use the top floor of the Arts and Crafts Building as a clubroom, and machinery is being installed which may be used by the residents of Mount Vernon.

St. James Workshop Club, Montreal, Canada. Jacob Markow is president of this group, which was organized recently. William Lavers is vice-president; Rebecca Markow, secretary; Samuel Smith, treasurer.

Dunkirk (N. Y.) Homeworkshop Club. The members visited a local machine shop where demonstrations were given on the use of the shaper, milling machine, and metal-cutting lathes. A group has been formed in radio building, and talks are given on radio topics to interest the other members.

Sterling Hobby Guild, New York, N. Y. Ten hobby enthusiasts recently formed this club and elected John Lake president; Isami Doi, vice-president; George Laughton, secretary; Ruth Peller, treasurer.

New Bedford (Mass.) Woodcraft Club. Asa Auger displayed his extensive collection of wood samples at a recent meeting. A follower of this hobby for the past ten years, Mr. Auger told many interesting stories about his collection, which includes more than 250 specimens from almost every country in the world. . . . Meetings are held twice a month in the workshop of the secretary-treasurer, Edward F. Frawley, and are open to all persons interested in woodwork. The club has a membership of 25 at present.

Fall River (Mass.) Homecraft Club. George Legault was elected president at the organization meeting recently and Oscar E. Briand, secretary-treasurer. The board of governors consists of Albert Boutin, Clifford Schlemmer, and Raymond Murray.

Brookhaven (Miss.) Homecraft Club. Members have constructed about 300 toys and 75 household items during the past six months. A. B. Carruth has been elected president and John S. Coleman, secretary. Wilmer Roberts is in charge of exhibits; Roger Coleman, publicity; John Williams, club photography. Meetings are held every Wednesday.

Southeast Homeworkshop Club, Huntington Park, Calif. Ben F. Worcester has been elected president of this new club; Ernest Firth, vice president, and Charles B. Cerates, secretary-treasurer.

Madison (Wisc.) Homeworkshop Club. A typical homeworkshop was set up and various projects displayed by members at the annual home and food show conducted by the Wisconsin State Journal and Capital Times. The club also participated in the annual hobby show in the local Y. M. C. A. The Hobby Council, representing various organizations including the Homeworkshop Club, sponsors a "Hobby Hour" every Sunday morning. Many toys were made by the club for the Empty Stocking Club last Christmas. Meetings are held on the second and fourth Wednesdays.

Capital Homecraft Club, Washington, D. C. Joseph Chlopicki was host to the club recently and displayed a Queen Anne coffee table and a lamp which he had just completed. Plans for the spring and summer were discussed at the home of H. E. Middleton, followed by a conference on shop and craftwork problems.

Lackawana Homeworkshop Club, Penticton, B. C., Canada. Francis Suckling is president; Alan Forster, vice president; Warren Williams, secretary; Dick Forster, treasurer.

Wilmington (Del.) Homecraft Club. Organized recently, this club is growing rapidly and plans to take part in the local Art Week observance. Permanent officers have been elected as follows: James A. Oberly, president; O. L. Dunn, vice president; John H. Davidson, secretary; G. W. Longacre, treasurer; Charles D. Painter, publicity secretary; James S. Wilson, librarian; Kenneth McKnight, George W. Ludwigson, and Earl L. Hood, board of governors. Committee chairmen are Charles R. Barbon, membership; John T. Mason, activities; Robert J. Smith, information

Mount Clemens (Mich.) Homeworkshop Club. Meetings have been discontinued until September when the club expects to have new, large headquarters and to conduct classes in woodworking, metal working, and mechanical and architectural drafting for young men and boys who do not have access to the high school. It will be backed by the City Commission and the county supervisors. There are twenty members at present. Officers are W. R. Coates, president; Rubin Ghainer, vice president; Carl Brandenburg, treasurer; John W. Riley, secretary.

Brookhaven Homeworkshop Club, Chester, Pa. Fourteen persons recently formed this club and elected the following officers: George T. Whiteley Jr., president; Francis W. Jackson, vice president; Norman L. Whiteley, secretary; Edward P. Marshall, treasurer.

San Diego (Calif.) Homeworkshop Club. Jens Thompson demonstrated the use of various lathe tools at a meeting held in a local hardware store. In using the 1-in. skew chisel, he made the finishing cut without the use of rests to show that the tool is simple to use when properly held. He also demonstrated the gouge and then allowed the members to try wood turning under his supervision.

Miami (Fla.) Homecraft Guild. Unlike most clubs, this organization plans an active summer because the members are too busy during the winter tourist season to spend much time on craftwork. Membership has jumped from fourteen to over fifty during the past year. Three exhibits were held at hardware stores, and the first annual competition closed May 28. Committees follow: rules and regulations, James M. Elliott, Seymour Brandes, Royce Chalmers, J. M. Davisson; exhibits and publicity, Will Smith, George C. Summerer, H. D. Yancey. Club headquarters are maintained on the fourth floor of the Miami Herald. Any craftsman visiting in the greater Miami area is invited to attend meetings. A library has been established, with Harry Lowe, Jr., as librarian. Officers are James M. Elliott, president; Seymour Brandes, vice president; A. E. DeVille, second vice president; Will Smith, secretary; Royce Chalmers, treasurer.

Wood-Ridge (N. J.) Homeworkshop Club. Four hundred persons attended the three-day second annual exhibition held recently. Approximately ninety pieces were on display. Seven prizes, consisting of tools and materials donated by local merchants, were awarded according to popular vote as follows: first, G. N. Schalk, inlaid picture display; second, E. Kohl, bird cage in metal; third, H. G. Hoffman, walnut sewing cabinet; fourth, F. G. Overbaugh, maple colonial lamp; fifth, F. G. Wormuth, (Continued on page 101)

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(Continued from page 100)

walnut cigarette music box; sixth, R. Neives, chestnut radiator cover and bookcase; seventh, L. J. Messenger, mahogany occasional table. Door prizes made by members were also distributed each night. The Popular Science Craftwork Award—a sterling silver medal—was presented to H. G. Hoffman for outstanding all-around craftsmanship.

Columbia Homeworkshop Club, Paterson, N. J. Howard Beattie has been elected president; Herbert Langer, vice president; James Fox, secretary; William Barth, treasurer. Meetings are held weekly at the president's home.

Lakeside Homeworkshop Club, Muskegon, Mich. Eleven workshop enthusiasts recently formed this club and elected Frank Pedler president; Clarence Redman, vice president; Floyd Lewis, secretary.

Fowler (Kans.) Homeworkshop Club. Richard Keith was elected president at the organization meeting; Clarence C. Youse, vice president; Glenn Himes, secretary.

Inland Workshop Club, Spokane, Wash. This group and the Spokane Homecrafters recently coöperated with the Associated Lumber Industry through its Hoo Hoo Club and the local office of the National Association of Wooden Box Manufacturers to stage a three-day homecraft exhibit in the Knights of Columbus Hall. Extensive publicity drew thousands to the exhibition, which was so successful that the Hoo Hoo Club plans another for next year. The Craft Club of Moscow, Idaho, received the most prizes. . . . The Inland Club inaugurated and supervised a general course in woodworking at a local high school this year. The course covered sixteen evenings under the supervision of two manual arts teachers. Some unusual projects were started, and the course has proved so helpful that similar courses will be presented next fall.

Topeka (Kans.) Homeworkshop Club. Members have been invited to submit plans for arranging the new headquarters of the club.

Homecraft and Modelmakers' Guild, Richmond, Va. Arrangements have been completed for the annual contest and exhibition to be held in the Richmond City Library.

Greenwich Village Homecraft Club, New York, N. Y. Raymond G. Foley has been elected president of this new group; Rabrun E. Steagall, vice president; William J. Kelly, secretary-treasurer.

Lowell (Mass.) Homeworkshop Club. Remy Bertrand is president of this group, the second to be organized in the city. Leo Hubert is vice president; Real Bolduc, secretary; and Emilien Gagnon, treasurer.

MEMBERSHIP IN GUILD NOW OFFERED FREE

THE National Homeworkshop Guild is anxious to help you organize a home workshop club among your friends and neighbors. By filling out the coupon below and sending it with a stamped, self-addressed envelope to Guild headquarters, you can obtain complete information without obligation. No membership dues are now required.

National Homeworkshop Guild
347 Fourth Avenue, New York

I want to take advantage of your special free offer and organize a home workshop club in my own neighborhood. Please send me all the necessary information. I am inclosing a large (legal size) envelope, self-addressed and bearing a three-cent stamp.

Name .....

Address .....

City ..... State .....

(Please print very clearly)

SOLVING THE MYSTERIES OF THE INSECT WORLD

(Continued from page 43)

moving the focusing knob slowly upward and then downward.

You will discover, in this way, that there are two sets of hairs, pointing in opposite directions. That is, some are on the upper surface, pointing toward the microscope objective, while others are underneath, pointing downward. This gives you a clew to the ingenious structure of the wing as a whole. It consists of two very thin, transparent membranes stretched, like the silk of an umbrella, over the stiff ribs or veins. The upper membrane is attached to the ribs, in most cases, more firmly than the lower, as you can determine by peeling off the membranes with dissecting needles and fine-pointed tweezers.

Part of the antenna of a moth, as seen by the microscope. Note the elaborate rows of hairs

When examining wings, particularly those covered with scales that glint with startling beauty when illuminated by reflected light at the proper angle, you will find it convenient to be able to turn the wing so that the angle can be varied. A handy tool for doing this is made by gluing a bottle cork about a half inch long to a short strip of thin wood, one end of which projects a quarter inch or so beyond the cork; and then pushing a sewing-machine or darning needle through the cork, near the top. Fasten the wing to the needle point with a bit of wax or glue, and clamp the device to the stage with one of the spring clamps, which engages the projecting part of the wood strip. A knob, for turning the needle easily, can be made by filling a knurled binding-post nut with solder and inserting the outer end of the needle into the hole before the solder hardens.

THE ingenuity of nature as displayed in the insect world crops out strongly in the hymenopterans, those insects whose winged members have two pairs of membranous wings in tandem. From an aerodynamic standpoint, it is desirable to have a large-area wing of unbroken surface; but from the standpoint of compactness, it is desirable to have a wing that can be folded back. Therefore the hornet, the wasp, and the honeybee, among others, have wings equipped with a strange-looking mechanism.

Along the forward edge of each rear wing is a row of tiny, curved hooks, looking something like the claws of a cat. The rear edge of each forward wing is curved over to form a groove. When the insect is at rest, wing sections on each side are folded back separately. But when the wings are extended for flight, the tiny hooks slide into the grooves ahead of them, securely locking the two sections together. This ingenious mechanism is perhaps seen best in a hornet, with the wasp and honeybee almost as good.

Wings of many insects, such as crickets, are equipped with sound-producing devices. The common house *(Continued on page 103)*

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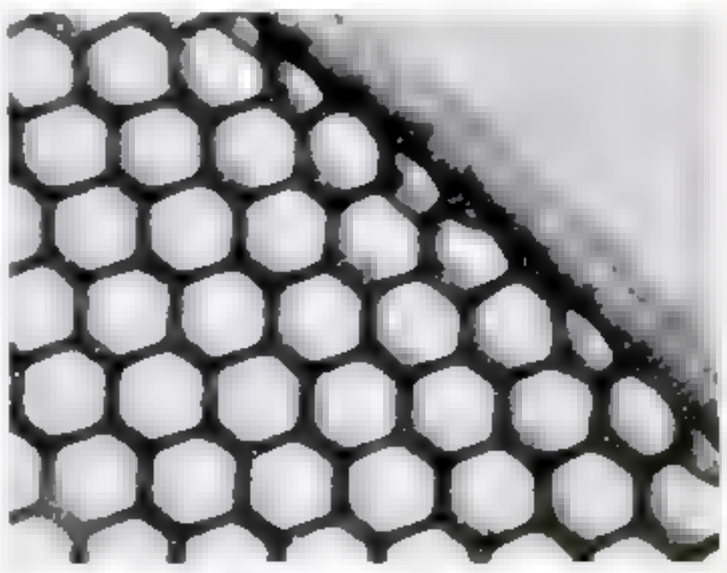
cricket has a drumlike area in its upper wings, bounded by a thick vein covered with horny ridges. Adjacent to this ridge in each wing is a notched "bow" resembling a file. The cricket produces its characteristic song, the microscope indicates, by rubbing these bows across each other, so as to make the drumlike area or tympanum vibrate.

Among the marvels of the insect world which the amateur microscopist can investigate at first hand is the compound eye. The house fly, the bee, the dragon fly, and other



Some of the six-sided lenses in an insect's compound eye. The outlining is black pigment

insects see their way about, not with a single pair of eyes, but with many, perhaps many thousand, tiny eyes, each as remarkable a piece of optical equipment as the microscope with which you view them. Collectively, these myriads of eyes occupy a considerable portion of the insect's head, and appear as two dark organs which frequently come together in front. In addition, insects usually have several single eyes, situated between the two compound ones.

If you place the head of, say, a mosquito on a slide and look at it, you will see the eyes as large, black masses through which no light passes from the mirror below. The edges of these black areas have a border made up of a series of little, glasslike bumps, remarkably even and uniform in shape. These are the outer surfaces of the numerous lenses which happen to lie in the plane of focus.

After an insect head has been allowed to stand in water until it has become soft and is easily torn apart, you can peel off the outer layer of the compound eyes. Scrape all of the black pigment from the inside surface, wash the layer, dry it, and lay it on a clean slide. You will find that it is a rather stiff, concave shell. To flatten it, make several cuts around the edge with a sharp scalpel, each cut extending a little way toward the center, and press the specimen flat against the slide with a cover glass. Look at it through the microscope, and you see a collection of tiny lenses. In most insects, these are six-sided.

THIS is the corneal layer of tiny lenses that focus light rays entering the compound eye. It is one of the most wonderful pieces of mechanism that you will find in the insect world.

Each tiny lens is composed of two plano-convex lenses, arranged with their flat surfaces together. Why two lenses? The answer, the investigators say, is found in the fact that the refractive indexes of the outer and inner lenses are different, just as your microscope lenses, if they are corrected for certain defects such as the inability to focus colors properly, are made of two kinds of glass. Thus nature, millions of years ago, produced in the eyes of insects a lens combination that human optical experts only recently succeeded in duplicating

Each pair of *(Continued on page 107)*

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Only letters from bonafide home study school students will be considered and these must contain the name of the school and the name of the company, or companies, for whom you have worked since graduation. (Names, however, will be deleted from the letters when published.) We also want to know the kind of course you took and the type of position you have held. Your own identity will be kept anonymous, if desired.

We are interested in facts, not literary ability, but please write clearly, completely, and keep your letter within 750 words. We are not looking for "get-rich-quick" stories or freak adventures, and authors must be prepared to substantiate the truth of the statements. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless sufficient postage is provided for this purpose. Address your contribution to Success Story Department, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y.

FLEXIBILITY OF HOME STUDY SAVED HIS JOB

A course in European History taken with the——————Correspondence School between September 1 and December 31 last year proved to be very valuable to me.

In the Spring of 1935 I had accepted the principalship of the——————Junior High School. At that time I was the principal of a high school in another State, but through correspondence with the Indiana State Department of Education I learned that although I had both A.B. and M.A. degrees I could not qualify for a principal's license without additional college credit.

The State Department, however, agreed to grant me a permit which could be converted into a license by the completion of two semester hours of European History within a stipulated time. Consequently, in order to stay on the job and at the same time prepare for the legal requirements of the license, I decided upon a correspondence course.

It was my understanding that I would have until August 1936 to complete the course and accordingly I worked at it rather leisurely. Then on December 15, when half-way through the course, I sud-

Secrets of Success

denly discovered that I had misinterpreted the ruling of the State Department and that I would have to have the credits by December 31!

Here was an emergency! Fifteen days to accomplish what I had planned to cover in eight months! What did I do? I simply speeded up my work, burned some midnight oil, and completed the course in time to have my credits in the hands of the State Department by December 31.

Certainly this was a situation which demonstrated one of the advantages of home study. Had it not been for the flexibility of the course, I should have been in an embarrassing "spot" since the rating of the———————— Junior High School would have been lowered and I would have endangered my position as principal.

I have found, among other things, that correspondence work is economical. It can be done when, where, and as fast as one wishes. You are not compelled to adhere to rigid time schedules, to keep in lock-step with others, or to spend a fixed number of weeks in completing a certain amount of work. This freedom enables one to suit the work to his own ability and environment without impairing the quality of the work, and thus affords people of all ages and stations in life a chance to continue to grow.

Scientists have long since exploded the theory that the older person cannot learn as rapidly or as easily as the youthful individual. These facts, combined with ever increasing leisure time, make it possible for young and old to profit through home study.

—*L.W.A., Richmond, Indiana*

HOME STUDY PENETRATES BARRIER OF DEAFNESS

I am deaf and the pleasures of sound others enjoy is something I have never known. However, as the result of my deafness, my visual sense developed early and when a child I amused myself for hours drawing my impressions of the things I saw about me and creating fantastic pictures . . . purely imaginary and doubtless of very questionable artistic merit.

As I grew older I wanted to take up this work professionally; to see my drawings reproduced and receive money for my efforts. This, I realized, required special training but on account of my affliction I hesitated seeking instruction at a resident school. A correspondence course in art offered by the———————— Schools solved this problem.

I can now say that, even without my handicap, I would prefer this home study method. The student receives a thorough training in art and the processes of reproduction, and at the end of the course has a permanent art reference library. In addition, one avoids many interruptions and other distractions which would have a tendency to retard creative progress. I shall always credit the———————— Schools with the training that has enabled me to make my most cherished dreams come true.

Secrets of Success

STARTED 33 YEARS AGO

The first recognition of my work came through a pen line drawing reproduction in the Wisconsin News, Milwaukee, over a year ago. Because of the interest this drawing created, the paper gave me a special write-up.

Being interested in religious subjects, I began submitting work to religious publications. Over a thousand reproductions of my original pen and ink drawings, "Thy Kingdom Come", were distributed in Chicago alone.

Aside from this work which I do in my home studio, I travel with my sister giving chalk talks before religious groups and organizations, and I have received many letters of commendation from leaders in the field of religious education.

I have just scratched the surface of opportunity in this work, but it has brought me happiness and opened broad horizons which I consider well worth striving for.

—S.E.L., Lindsborg, Kansas

Perhaps some of your readers can profit from the experience of an old timer. It's over thirty years now since I took my first correspondence course and in the light of all that has happened to the world and what *could* have happened to me, I feel that when I enrolled it was one of the wisest things I ever did.

Back in 1893 I started as an oiler in an electric light plant and by 1897 I had worked my way up to chief engineer. Some might think that was success enough for anybody but I wasn't satisfied, so in 1903 I began a correspondence course in mechanical engineering with the——— School.

By doing so I fitted myself for better work, and with a real understanding of what I was doing I have always kept busy regardless of panics and depressions. During this last one I have been employed without the loss of as much as an hour; in fact, I haven't had a vacation in seven years (although I have had one due me every summer) because the company hasn't been able to find any one who could fill my place, even temporarily.

What's more, instead of having my salary cut, as happened to so many people in the past few years, I have had a voluntary raise of 25% besides earning a very nice bonus.

Could you ask for any better evidence of the value of home study?

—W.C.D., Dallas, Texas

REMOVING BROKEN TAPS FROM SOFT METAL

It is often difficult to remove small broken taps and drills from metal, especially if the metal is soft, such as aluminum or copper. For aluminum get five cents' worth of caustic soda solution and with an eye dropper squirt the solution around the broken tool. Repeat this several times and then wash out with kerosene. You will find the tap or drill can be easily removed with small pliers or tweezers. Raw muriatic acid instead of soda solution should be used for copper.

—W.C.C.

SOLVING THE MYSTERIES OF THE INSECT WORLD

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tiny lenses is mounted at the big end of a tiny cone or pyramid. If you slice a compound eye so that the cut is parallel to the axes of some of these cones—a task, incidentally, that requires considerable skill and careful preparation—you can see the construction of the cones. One way of making thin sections of eyes is to harden the head of a freshly killed insect for three or more days in two-percent chromic acid solution (about one gram of chromic acid to forty-nine cubic centimeters of distilled water). Then embed the head in something to hold it, like cocoa butter or paraffin, and slice it into thin sections, preferably on a microtome. (P.S.M., June '33, p. 32).

THE cones are surrounded by a black, light-proof pigment. Just behind the lenses of each cone the pigment extends inward to form a diaphragm, like the iris of your own eye. The lenses focus the image of objects within range, at the small end of the transparent cone, where it is joined to an optic nerve. Thus, the insect sees a complete image for each little eyelet in its compound eyes. The common house fly has some 4,000 of these tiny eyes, while the dragon fly boasts 24,000.

With a microscope, you actually can see the tiny images formed by each lens of a compound eye. Focus first on the lenses of the corneal layer mounted on a slide, in air; then rack the microscope tube back slightly, so that the objective focuses in the plane of the tiny images formed by some of the insect lenses. By tilting the substage mirror at various angles, you can center the images of such objects as a window across the room, your fingers held a foot or so from the microscope and between it and a lighted window, or an unshaded electric-lamp bulb. It is possible even to photograph the tiny images formed by the insect's eye, as in one of the illustrations accompanying this article.

It is not a difficult matter to obtain stings of bees, wasps, hornets, and the like for examination. Simply grasp the posterior tip of the freshly killed insect's abdomen with tweezers, and squeeze. If you do it right, the sting case will pop out where it can be grasped with another pair of tweezers. You will be surprised to find how hard it is, and how easily it slips out of the tweezers. Pull the sting away from the body. This usually brings some muscle fiber, and perhaps the poison sac. Drop some water on a slide and lay the specimen in it.

By careful manipulation with a dissecting needle, you can extract from the sting case the pair of tiny, barbed lancets that do much to make the insect's weapon as efficient as it is. The stings of honeybees and the like are not easily pulled out of the flesh which they have penetrated.

WHEN the insect "sits down," the lancets, propelled by powerful muscles, enter the flesh, guided by the grooved sheath. Then poison secreted by special glands and stored in the poison sac or reservoir, which you may be able to see on your specimen, flows down the sheath groove and along the barbed darts.

You can embed the darts and sheath in balsam immediately after drying them thoroughly, for permanent mounting; but if the poison sac and muscle fibers are to be preserved, they must be completely dehydrated in alcohol of increasing strength, before mounting.

The number of interesting insect parts for study are countless. Two more suggestions for the beginner are: Feet of the house fly to show their unusual pads; the legs of honeybees, which have many surprising and odd devices, as scale-removing pincers, combs for cleaning, and baskets for carrying pollen.

THE BICYCLE COMES BACK

(Continued from page 41)

steering wheels, built-in speedometers and lights. There are tandem machines, three-seaters, six-seaters, and one "centipede bike" carrying ten riders.

Typical of the response of manufacturers to the growing demand for new and better bicycles is one streamline machine distributed by a leading mail-order house. Built on rakish lines, it has the seat, the luggage carrier, the framework, and even the pedals made in streamline design. It has a built-in speedometer, horn, and headlight—with a battery concealed in the broad upper bar of the frame—a red-glass rear reflector, and a special rubber-tipped stand bar which swings down against the ground and holds the machine upright when it is parked.

SEVERAL makers have introduced a combination horn and light. The accessory is housed in a streamline case which clamps onto the handlebars, the light bulb and reflector in front and the electrically operated horn at the rear. A button placed near one of the handlebar grips operates the horn.

Another ingenious combination bicycle accessory is a lock with a reflector which serves as a tail-light. The device is attached to the framework at the back wheel with the reflector pointing to the rear. By pressing a small handle, the cyclist can snap a strong metal rod between the spokes of the wheel, thus locking the machine when it is left unguarded. Only one who knows the combination of the lock and turns the handle in the correct manner can unlock the wheel.

Another type of lock is housed in the fork crown of the front wheel. When a key is turned, the front wheel is locked in place at such an angle that the bicycle cannot be ridden or wheeled away.

Probably the most radical innovation in bicycle design is a new streamline two-wheeler that can be pedaled from a comfortable sitting position in a rubber-cushioned, chairlike seat, and guided with an automobile-type steering wheel. It boasts balloon tires, twin headlights, and a tail-light. Small-diameter wheels and an elongated body give it a low center of gravity to minimize wabbling and the danger of spills.

Bicycle trailers form another field in which inventors have been busy. Not long ago, a Chicago mechanic produced a collapsible trailer for use on bicycle tours. Clamped to the frame of the bike by a metal connecting rod, the novel trailer weighs less than fifty pounds and is only three feet long. It is built of wood in the form of a small box sliding into a larger one. At night, it can be extended lengthwise into a comfortable six-foot bunk.

At an eastern seaside resort, a life-saving trailer made its appearance last summer. Essentially a stretcher on wheels, the trailer is quickly attached to a bicycle for emergency runs from beach life-saving stations.

IN THE wake of the bicycle's rising popularity have come a number of exciting new sports. Bicycle polo, for instance, has appeared in many parts of the country. At Palm Springs, Calif., the playground of the movie stars, cycling and archery have been combined. Teams of two contestants each, riding on tandem machines, circle around a fixed target. The "pilot" sits on the rear seat and guides the machine while the archer aims and shoots the arrows as the wheel skims past the bulls-eye. According to enthusiasts, the new sport requires unusual skill and a fine sense of timing.

Cycle racing, once a major sport, is also coming back into its own in amateur circles.

Literally hundreds of races, ranging from short sprints to "century runs" of 100 miles, are scheduled for this summer in all parts of the country. Each year, the Century Road Club of America, with headquarters in St. Louis, Mo., sponsors 100-mile road races and holds an annual cycling meet in its home city.

At thirty seconds past midnight each New Year's, a crowd of California cyclists gets away for a unique 100-mile bicycle race over a course laid out around San Francisco Bay. The event is sponsored by the New Century Wheelmen of San Francisco. In the old days, the "century riders," who entered the 100-mile grinds held throughout the country, were famous in sport.

ONE of the celebrated road riders of the nineties was "Big Bill" Rischel. His most famous exploit was cycling across the Great Salt Lake Desert, in Utah. That desert ride proved to be more than a stunt. It blazed a trail over the barren wastes which was later followed by highway engineers when they laid out the Utah section of the famous transcontinental Lincoln Highway.

Modern racers have many engineering innovations to aid them. One of the latest is an extra-light bicycle made of aluminum alloy. Completely equipped, this featherweight bike tips the scales at only thirteen pounds. Such machines are expected to play a part in setting new speed records in amateur and professional racing.

Last year, Ernest Ohrt, former racing star, now a representative of the League of American Wheelmen, promoted races in twenty cities, seeking talent for the team which will go to the Olympic Games in Berlin, Germany. He uncovered a number of topnotch riders.

Another outstanding development of the bicycle boom is the establishment of cycle paths in city parks. In the nineties, it was the bicycle rider who led the agitation for better roads. Now, the present-day enthusiast argues, the automobile age can repay its long-standing debt by providing such paths for bicyclists away from the dangers and fumes of the motor traffic which monopolizes our highways.

At Chicago, in response to a monster petition signed by 165,000 bicycle fans, 100 miles of cycle trails are now being established. Detroit, Mich., has established similar "handlebar paths" in several of its parks, as have Washington, D. C., Oklahoma City, Okla., and New York City. As a result of hundreds of requests, Atlantic City, N. J., now permits cyclists, at certain hours of the day, to ride along its famous boardwalk.

To safeguard bicycle tourists riding on main highways, cycling organizations are now strenuously advocating that states authorize the construction of special paths along the shoulders of roads.

With improved machines and better highways, the fun of cycling has increased. Daily, new recruits are joining the 4,000,000 enthusiasts now speeding along on two-wheelers. The bicycle, economical and dependable, has got its second wind.

METER INDICATES COLOR OF EYEGLASSES NEEDED

EYES can now be examined to determine the color or tint of eyeglasses which will protect the wearer from the glare of the sun or any other strong light. A new device, called by its inventors a glarometer and looking like a lantern-slide projector, makes it possible to ascertain the intensity and color of light which "blinds" the person whose eyes are being tested. From a scale reading on the instrument, the inventors declare, the examiner is able to tell the exact shade of glass which should be worn by the individual to shield his eyes from glare.

CHEMICAL WIZARDS REMAKE THE WORLD

(Continued from page 11)

Its base is a white, flaky compound known as diphenyl—a chemical relative of synthetic geranium perfume—which turns to vapor at about 500 degrees F. Since it holds more heat than steam, and can be raised to a greater temperature without developing dangerous pressure, the new heat-carrying material has already found industrial applications.

HOME refrigeration, too, has come in for attention from the chemical engineer. Ice boxes employing "dry ice," or solidified carbon dioxide, as a refrigerant have recently been introduced, particularly for use in hot regions of the country where ice factories are remote and where electricity is not available. The dry ice is placed in an insulated inner compartment so that it will not withdraw heat too rapidly, as its temperature of 109 degrees F. below zero would otherwise freeze solid the whole contents of the refrigerator. Its chilling effect, transmitted through metal fins on the compartment, can be regulated to keep the ice-box temperature within the desired limits. A novel advantage resulting from evaporation of the refrigerant is the atmosphere of carbon dioxide formed within the ice box, which is said to retard bacterial growth and also to check the spread of food odors.

Frying pans of glass with superior heat-resisting qualities, for cooking on top of the stove, are the result of a recent chemical improvement upon the glass used in standard oven ware. Behind this development lies the story of chemists who turned cooks in a Corning, N. Y., laboratory to test glassware made from as many as 1,500 promising new formulas. Tons of potatoes and countless hamburger steaks sizzled in their dishes. Hungry dogs, more pleased than the scientists themselves with some of the first results, got many of the meals. Some of the food was burned black—purposely—to see what the glassware would stand. Eventually the experimenters arrived at the formula they were seeking, which is embodied in the glassware that has just reached the market.

No article used about the home is too inconsequential to attract the interest of skilled chemists. One has just produced a "nonskid" floor wax by impregnating ordinary wax with rubber, preventing falls on a freshly polished floor. Another has improved cedar chests by perfecting a transparent exterior coating which retains both the natural oil of the wood and its moth-repelling aroma. Thus, even to the smallest details, chemists are helping to make the world a better place to live in.

WINE TO HELP DRIVE ITALY'S MOTOR CARS

WINE and driving do not mix well but soon Italy's motor cars will be consuming the surplus of her bumper "vino" crop. The wine, it is reported, will be converted into alcohol which will be blended with gasoline as a motor fuel. Italy already has a law making the use of an alcohol-gasoline blend compulsory.

RED LIGHT IS BEST FOR CATCHING WORMS

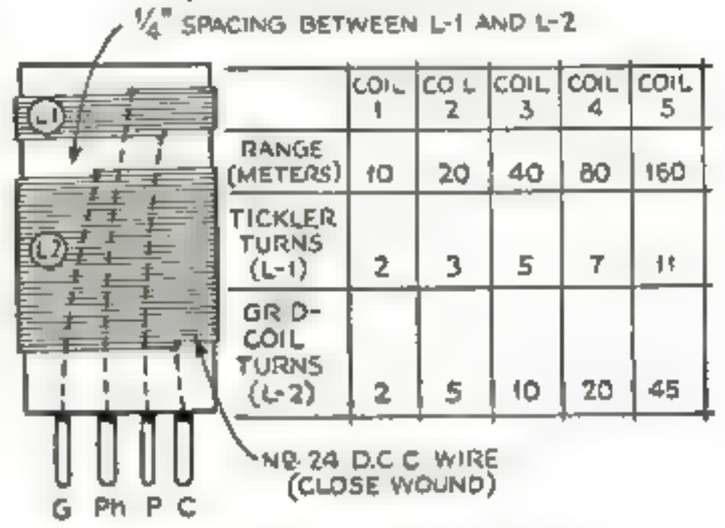
FISHERMEN should use a red light when searching for worms, according to W. R. Walton of the U. S. Department of Agriculture. Recent tests indicate that nightwalkers and other worms are insensitive to red light but quickly retreat into the ground when exposed to the rays of an ordinary lantern or flash light. Anglers are advised to use a red lens or to cover the glass with red paper.

METAL-TUBE RECEIVER

(Continued from page 51)

evidenced by a rushing sound in the headphones. The antenna trimming condenser (C_4) then should be adjusted with a screw driver to balance the receiver and the antenna. The longer the antenna, the less the capacity necessary in the trimming condenser. Turning the set screw out and allowing the plates to spread apart lessens the capacity of the trimming condenser; tightening the screw increases the capacity.

How to Wind Coils



	COIL 1	COIL 2	COIL 3	COIL 4	COIL 5
RANGE (METERS)	10	20	40	80	160
TICKLER TURNS (L-1)	2	3	5	7	11
GRID COIL TURNS (L-2)	2	5	10	20	45

Specifications for winding the coils. Four-prong composition coil forms should be employed

The adjustment of the antenna condenser has a marked effect upon the volume of the set. The greater the capacity that can be placed in the antenna circuit without stopping the oscillation, the louder the signal. Because of the peculiar characteristics of the type 6C5 tube, a surprising amount of capacity, as compared with other tubes, may be used. This close coupling between the antenna and the tube is undoubtedly one reason for the surprising output of the circuit.

Correct tuning is a knack which can be acquired with practice. Stations should be tuned with the set in an oscillating condition and then the regeneration control "backed off" until the oscillation whistle stops. For the reception of voice stations, the regeneration control should be adjusted to a point just before oscillation begins. Code stations, on the other hand, are received with the set oscillating.

The following parts are needed in the construction:

C_1.—Midget variable condenser, .00014 mfd.
C_2.—Fixed condenser, .00025 mfd.
C_3.—Fixed condenser, .0002 mfd.
C_4.—Mica trimmer condenser, 0-50 mmf.
C_5.—By-pass condenser, .25 mfd.
R_1.—Resistor, 750,000 ohm, ½ watt.
R_2.—Variable resistor with switch, 500,000 ohm.
L_1, L_2.—Plug-in coils, see text and coil chart.
RFC.—Short-wave radio-frequency choke, 2½ mh
Miscellaneous.—Wafer sockets (one four-prong and one octal), wire, bolts, metal chassis, vernier dial, cable, etc.

STRATOSPHERE MAY HAVE OWN KINGDOM OF GERMS

Does a world of living things exist high in the air above our own, distinct from the life realms of the soil, the earth's surface, and the sea? Germ-catching plates exposed by aviators at high altitudes always show a few living microbes, hitherto considered as strays from the earth. A Welsh scientist, however, suggests that they may be visitors from an ocean of germs that dwell permanently in the stratosphere. Some types, he points out, might depend upon a coating of opaque pigment to absorb sunlight, keeping them warm and also protecting them from the fatal effect of intense ultra-violet rays at such an altitude. Others might inhabit water droplets of high-level clouds or floating particles of dust.

AT SEA WITH THE TANKER FLEET

(Continued from page 32)

last, ready for sea, the tanker moves away from the dock, and is soon hull-down on the horizon, her single squat stack disappearing in the evening sun.

Each dispatcher aims for speed in this "turn-around," for time is money to the tanker fleet. Perhaps the *Walter Jennings* holds the record for quick turn-around. She berthed at San Pedro, Calif., at ten o'clock one spring morning, and sailed eleven hours and twenty-nine minutes later, meantime having gorged herself with 109,216 barrels of crude during a seven-hour spell of pumping—an average intake of 15,535 barrels an hour.

THE tankers sometimes load without entering a harbor, using floating hoses and pipe lines that run along the bottom of the sea. For instance, one pipe line runs eighty miles from an oil field near Bakersfield, Calif., across the mountains, terminating on the coast at Ventura. Pumped to the crest, the black gold flows by gravity to the ocean's edge. At Estero, Calif., a wharf and pipe line extend a full mile out into the Pacific. At the end of the line, the hose is made fast to a floating buoy.

When a tanker arrives to load, she is guided into position by a spotting buoy placed 1,300 ft. from the floating buoy, and in direct line with the hose. She drops both anchors, with the cables forming a V, and fixes five twelve-inch Manila lines to near-by buoys, which in turn are held in position by anchors.

After the ship is made fast, the submarine hose is hauled aboard and attached to the ship's pipe line. The submarine telephone is connected, and orders are given to the refinery on the near-by hills to turn on the oil. Gravity completes the delivery, and half a day later, the tanker puts out to sea, her hold filled with black oil.

Every mechanical or scientific appliance connected either with movements of the tanker from port to port, or with loading and unloading, is carefully designed to meet the exacting demands of this hazardous service. Each ship can be ballasted to suit conditions, no matter whether she is empty or loaded. The location of the stack aft has special value. Were it amidships, it would serve as a pivot in a heavy blow, thus turning the ship broadside to the wind and sea. In its location aft, though, it catches the wind and tends to keep the vessel turned into the wind if she is not maintaining enough headway with the engines. It's really an "air anchor," dragging in the wind as a floating sea anchor drags in the water.

IN NAVIGATION, the tanker is aided by the radio direction finder. This consists of a series of loops mounted on a vertical shaft piercing the pilot house. In front of the navigator is an adjustable dial, representing a compass card, over which are parallel wires showing the position of the loop aerial. No matter how thick the weather, a skilled navigator can determine the position of his ship exactly by turning the aerial until signals from each of two coast transmitting stations come in loudest. Knowing their locations, he draws lines from them on the chart, in the directions indicated by the radio. The intersection of the lines shows the ship's position.

The average 100,000-barrel tanker contains nine tanks on both port and starboard sides, as well as several summer or wing tanks. In winter the wing tanks are kept empty, making the vessel sit higher in the water and enabling her to ride out storms with less difficulty. Gasoline and fuel oil are separated by cofferdams, while on some ships the engine room is separated from the cargo space by a two-foot wall of water which absorbs heat.

Despite these elaborate precautions, fire sometimes breaks out. A blaze was discovered between decks abaft the engine room on the *Prometheus*, between Hamburg, Germany, and Baton Rouge, La. Refusing to radio for aid, the captain headed the ship into the wind so the flames would not be fanned forward, and proceeded to fight them. But the fire spread and soon blew out the bulkheads, bringing the flames in close proximity to the tanks. The engine crew barely escaped with their lives. Meanwhile the tanker *Inverarder* hove into view and stood by. For two days the captain and some of the crew battled the raging inferno, and at last killed the blaze without outside help.

THE ability of tankers to ride out even the severest blow by taking in water or pumping oil on the raging sea has saved more than one crew.

Through the treacherous Straits of Magellan, the *E. T. Bedford* pounded over mountainous seas, headed from Montevideo, Uruguay, to Los Angeles, Calif., her tanks filled with black oil. Overloaded, she threatened momentarily to founder. At last, faced with a decision to save ship and crew at the cost of part of his cargo, the master ordered the pumps started, and soon 25,000 barrels of black gold were spreading over the sea. Thus lightened, the *E. T. Bedford* proceeded at quarter speed until the storm abated, and reached her destination only a few hours behind schedule.

Larger modern tankers have a capacity that staggers the imagination. When the *C. O. Stillman*, 585-foot Diesel-driven vessel, arrived at Bayonne, N. J., not long ago with 155,000 barrels of Peruvian crude, she delivered in a single load more oil than was produced in any one day of the first thirty-two years of petroleum production, from 1876 to 1909. The world's daily average during the first twenty-seven years would represent only two thirds of a cargo for this great tanker.

The tanker fleet is a most important asset in time of war. During the World War, each tanker was convoyed by destroyers, shielded from submarine attack by smoke screens, and generally given the same protection as a troopship. At the close of hostilities, 226 tankers were engaged in supplying petroleum to the Allies wherever it was needed throughout the vast arena of war operations.

But what happens to tankers when their seagoing days are done? An oil company operating along the Louisiana coast found an answer. Instead of relegating three old ships to the scrap heap, the operator stationed them permanently at docks to serve as storage tanks for oil production.

THE *Louisiana*, in the Lake Barre field; the *Tampico*, at Caillou Island; and the *West Lake* in Cat Island Pass, accommodate a total of 122,000 barrels of crude and save the cost of building shore tanks of equal capacity. All these ships have been left intact, and include radio stations, living quarters, and pumps.

During her active life, the tanker approaches more closely the "perpetual motion" ideal than any other means of transportation. During her first five years she serves in the "clean trade," transporting refined oils to the ends of the earth. Then, having begun to succumb to corrosion and erosion, she gives place to a new ship and takes up the burden of carrying crude. Yet, so long as she remains afloat, she will enter the harbors of the world only long enough to drink deeply her liquid burden, to be away at sundown for distant ports.

HOME EXPERIMENTS SHOW SECRETS OF FIRE

(Continued from page 49)

carbon monoxide, aldehydes, and acetylene.

How a Bunsen burner can be prevented from "striking back" by cooling its gas mixture may be shown with the aid of your lamp chimney. Support it above a Bunsen burner by means of a cork with a close-fitting hole for the burner stack, and arrange a ring of heavy copper wire within the glass chamber as shown in one of the diagrams. Turn on the gas and ignite it at the top of the chimney. The flame will travel down the chamber until it reaches the copper ring. It should stop there. The wire dissipates the heat; and if it does not do so rapidly enough to arrest the travel of the flame, a small piece of wire screen, cut and fitted to the ring, will prove effective. An improved type of Bunsen burner, called the Meker burner, makes practical use of this principle, employing a grid of metal to keep the flame from "striking back."

WITHOUT changing the adjustment of the air ports, you can turn the blue flame of a Bunsen burner into a yellow one. Lead the gases from a near-by candle or oil flame into the Bunsen flame, through a glass or metal tube, and the particles of solid carbon thus supplied will turn the trick. The blue flame of an alcohol lamp may be changed into a yellow one in the same way. Throwing soot or charcoal into a blue flame will also make it luminous

Cooling a yellow flame, on the other hand, may turn it into a blue one. Hold a sheet of metal in a slightly luminous Bunsen-burner flame, and the yellow color will disappear. Warm the back of the metal with heat from another source, however, and the luminous mantle returns. The metal, unless auxiliary heat is provided, conducts heat away from the flame and causes the change. A slightly yellow Bunsen-burner flame also ceases to be luminous when it is cooled by admitting nitrogen or carbon dioxide through the air ports along with the air. The reasons for these changes still are not fully understood.

If a flame is cooled sufficiently, it is extinguished. You can put out a candle merely by holding a spiral of stiff copper wire in its flame

In the preceding experiments, the light emitted by luminous flames has been due to the presence of carbon particles. You should not jump to the conclusion, however, that all yellow flames owe their light to incandescent carbon particles. A colorless flame in which salt is sprinkled acquires a brilliant yellow tinge; here, heated particles containing the element sodium, and not carbon, are responsible.

IT IS perfectly possible, too, for a flame that contains no solid particles at all to emit light. An example is the flame produced when phosphorus burns in chlorine gas.

A non-luminous flame may produce light by heating a foreign material. In a Welsbach burner, a Bunsen flame is used to heat a mantle consisting of a skeleton or ash of rare earth oxides, thorium oxide and cerium, to incandescence. The higher the temperature, the more light is emitted.

Neither flame nor heat is necessary for the production of some kinds of light, as the "cold" light of the firefly shows. Phosphorescent substances, such as the sulphides of calcium, barium, and strontium, also emit light unaccompanied by heat. An amateur chemist often meets with difficulties in preparing satisfactory luminous compounds from these materials, but the phosphorescent preparation described below is easy to make.

Obtain some crystals of citric acid and warm them in a small *(Continued on page 113)*

HOME EXPERIMENTS SHOW SECRETS OF FIRE

(Continued from page 112)

porcelain evaporating dish. No water need be added; the crystals melt in the water they naturally contain, which is called their water of crystallization. Add to the liquid a small amount of an organic dye known as fluorescein, and stir with a glass or iron rod to insure thorough mixing. Then remove the source of heat and allow the dish to cool in a darkened room.

As the citric acid crystallizes, cracks open up in the solidifying mass and a glow spreads through it. The mysterious illumination is bright enough to permit reading printed matter held close to the dish. It is enhanced if the compound is exposed to a strong light before cooling.

THE more slowly the preparation cools, the longer the phosphorescence or glow will last. It is a good idea, therefore, to use a sand bath or a small electric crucible heater or toaster for warming the compound. Since these cool off slowly, the glow from the citric-acid melt will be prolonged.

If citric acid is not readily available, boric acid—also known as boracic acid—may be used in its place. In this case, place some of the crystals of acid in an evaporating dish and moisten them with a solution of fluorescein, made by adding the dye to water containing a small amount of sodium hydroxide. Heat the mixture gently with a Bunsen flame. When fusion is complete, as shown by the cessation of the swelling that first occurs during heating, remove the flame; and the compound, taken into a dark room, will be seen to glow. As in the previous case, preliminary exposure to a strong light improves the phosphorescent display.

Tartaric acid, and other organic acids, offer an amateur chemist an opportunity to experiment with variations of the compounds described above; and perhaps you may find it possible to alter the color of the glow by adding small amounts of other dyes together with the fluorescein. Care should be taken not to heat organic acids excessively, in making preparations of this type, as they would decompose and char.

WARMED ICE IS BEST FOR VEGETABLE PACKING

ICE should be "warmed up" before it is used as a cold packing for shipments of vegetables, recent investigations by the U. S. Bureau of Plant Industry have shown. The temperature of ice varies according to the temperature of the room in which it is stored. Ice crushed in the vegetable-packing plant and immediately blown over the produce, it was found, sustains little change from its storage temperature. Used as a top-icing in this manner, it was discovered to be the cause of considerable damage to lettuce and carrots examined on test shipments. When ice was used in chunks and placed over similar vegetables after they had been loaded in the freight car, there was no damage to the produce because there had been an interval in which the ice had a chance to "warm up."

NEW AUTO MUFFLER HAS FILLER OF GLASS WOOL

BALLS of glass wool absorb the sound of exhaust gases in an automobile muffler designed by a German inventor. Packed in the muffler casing, they are held in shape by wire netting. Although the gases encounter little resistance in passing through, the noise is said to be effectively dampened.

WHEN YOUR CAR WON'T RUN

(Continued from page 54)

intake isn't clogged with a stray piece of rag or paper or leaves, then it couldn't be lack of air."

"So that leaves nothing but the ignition," Blarsden interrupted

"Plus the possibility of clogged carburetor jets," cautioned Gus.

Blarsden shook his head hopelessly. "But it certainly isn't a quick job to take a carburetor all apart and clean it on the road," he protested.

"Why do that? Nine times out of ten, you can clear dirt or water out of a carburetor by pulling the choke all the way out and turning the motor over several times with the starter. The higher vacuum forces the dirt through the jets. In fact, that's the first thing to do when a car stops suddenly on the road. And it's also the first thing to do if a motor starts to buck and jump, and acts as though it were going to quit. When the motor is running, you get the same effect by pulling the choke all the way out and at the same time opening the throttle all the way. Clogged jets often show up first in stalling when the motor is idling."

"I'LL remember that one," Blarsden remarked. "But I don't quite see how you tell whether the gas is getting to the carburetor or not, even when you know the tank has gas in it. What if the fuel pump isn't working?"

"Look here," Gus replied, lifting the hood and pointing at the carburetor. "This car, and all the rest of the new models, are fitted with fuel pumps and down-draft carburetors. The quickest way to check whether the gas is feeding to the carburetor or not is to disconnect the gas pipe at the carburetor, step on the starter with the ignition turned off, and then see if gasoline comes out of the pipe."

"But, suppose you can't see the end of the pipe from the driver's seat?" Blarsden asked. "You'd be stumped in that case if you were driving alone, wouldn't you?"

"Why not slip over into the front passenger's seat and work the starter with your left foot? Or if you still couldn't see the end of the pipe, then why not work the starter with your hand from under the hood?"

"I should have thought of that," the car owner grinned

"You probably would have, if you'd been up against it on the road. Now, after you've decided that it can't be anywhere except in the ignition system, you can eliminate a lot of possible ignition troubles just by turning on the ignition switch and watching the ammeter. If it shows the same amount of current flowing that you usually get under the same conditions, then it can't be a broken primary wire, a dead battery, or a short circuit. If the meter shows no current when you turn it on, give it a slight turn by a touch on the starter so as to be sure you are not being fooled by the timer contacts being open.

"FROM there on," Gus continued, "it's just a matter of checking each part of the ignition system. If there is any clearance at all under the breaker cam shoe when the points are in contact, and you can see the points separate at the break, then it can't be anything wrong with the timer."

"But I thought the timer points had to open just the right amount," Blarsden objected.

"That's true enough, if you want the best efficiency," Gus replied, "but the motor will still run so long as the points actually close and open, even if the gap is away off from where it ought to be.

"When you're sure it can't be the timer that's stopped the car, the next step is to check the spark by holding the distributor head so that the center contact is about a quarter of an inch from any convenient metal part, while you open and close the timer contacts by hand. If there is a clean-cut, sharp spark from the distributor terminal, and hardly any sign of a spark at the timer contacts, then you can be sure it isn't either a broken-down spark coil or a shorted condenser."

"Golly!" exclaimed Blarsden. "You've got down to the point where it can't be anything but the spark plugs. And I know that bum plugs can't stop a motor suddenly; they just couldn't all go bad at exactly the same time!"

GUS laughed. "That's right enough," he agreed. "If you got that far without locating the trouble, there'd be only two possibilities left. One is a loose connection in the ignition wiring that had jarred loose and then made contact again after the motor stopped, and the other is that the carburetor jets are clogged with dirt so solidly that the extra vacuum won't force it through.

"Chances are, though, that a sudden stop means something wrong with the ignition system. And if there is, you can generally bank on either being able to fix it easily, or not at all. A broken wire is a cinch to fix. And there's nothing to resetting the timer contacts, at least well enough to get you to the next service station. If either the coil or condenser has gone completely dead, you're sunk, but if they're only partly shot, you often can get the car going after a fashion, merely by closing all the spark-plug gaps to a tiny opening about equal to the thickness of a piece of paper."

"So there aren't any other things that can stop a car," Blarsden observed, starting his motor—this time without any difficulty. "It's a relief to know that, anyhow."

"Don't fool yourself," Gus grunted. "There's plenty, and some of 'em are sudden enough, but they don't usually leave you with any doubt that something is radically wrong before the car actually stops. That goes for a broken connecting rod, for example."

"How about a broken valve?" Blarsden offered.

"A broken exhaust valve won't even stop the motor unless it happens to get in the cylinder and cause a jam that wrecks the whole show. A broken intake valve raises hob with the gas mixture, and may cause a smash like a broken exhaust valve."

"WELL," Blarsden said, as he threw the car into gear, "thanks a lot, Gus, for all the help. I'm going to keep all that dope tucked away in the old bean where I can use it the next time the motor dies mysteriously. Got to drift along now."

"So long," Gus grunted. "By the way—there's just one thing I forgot to tell you about, that'll certainly make you stop mighty quick."

"What's that?"

"A blow-out!" chuckled Gus.

SAYS FACIAL FEATURES GROW LARGER WITH AGE

As a person grows older, his features alter in pattern. His nose becomes wider and longer in proportion to the size of his face. His ears lengthen. His mouth spreads wider. These facts, revealed in thousands of measurements by Dr. Ales Hrdlicka, Smithsonian Institution anthropologist, explain the vaguely felt change in the appearance of an old friend encountered after a lapse of years.

This One

CARX-R4W-RWJL

WEIRD PLANS PROPOSED TO MAKE IT RAIN

(Continued from page 35)

weather maker. Officials of an Eastern race track, in 1930, actually engaged the services of one of these specialists. He was commissioned to set up his apparatus and attempt to prevent rain during the week of horse races, at a fee of $1,000 a day and $2,500 for Saturday. Fortunately for him, not a drop of rain fell the whole week. Following his apparent success, the expert was rehired for one day the next week. It poured.

Government weather experts supply the epilogue. So far as is known, they say, no man has ever succeeded in producing or preventing rain.

Attempts to control other kinds of weather have fared no better—though not for want of trying. One inventor would improve our national climate by placing a 3,000-mile string of coal stoves along the Canadian border, to keep blizzards away!

ANOTHER produced a more imaginative plan. Let a windbreak of fifty-foot evergreen trees be planted, he suggests, on parallel ridges running along our northern boundary. There might be 100 such "shelter ridges," spaced about 500 feet apart. Now, suppose a layer of polar air, 5,000 feet deep, sweeps down from Canada. As it crosses the border, the first shelter ridge will clip off the lowest fifty feet of the cold air stream. Deprived of its underpinning, the remaining 4,950 feet will settle to earth and continue onward until it hits the second ridge, when another fifty feet will be amputated. Thus, the frigid blast will lose a fifty-foot slice at each ridge, until the final one annihilates the last trace of polar cold. Follow these directions, the sponsor of the plan maintains, and America will become a tropical paradise. Even if it were practical to carry out so vast an undertaking, however, skeptics may reserve their opinion as to whether the wind would fall into the trap so carefully laid for it.

The best that man can do, meteorologists insist, is to adapt himself to existing conditions. He can't force rain to fall on parched fields, but he can build irrigation systems to water the soil. He can't prevent the spring rains that cause floods, but he can plant trees to help the water soak into the ground, and build dams to stem the raging torrents.

Sound advice, no doubt—but it's safe to wager that inventors, with indomitable optimism, will go right on thinking up bigger and fancier schemes for controlling the weather!

NEW WHITE CLOTH MAKES SUNBURN-PROOF APPAREL

PERSONS who are extremely sensitive to sunburn are protected by a new white rayon cloth which filters out the burning ultra-violet rays of the sun. Heretofore only fabrics colored by certain dyes were known to shield the wearer against these rays so that no such white, summery-appearing material was available for wearing apparel. In making the new fabric, colorless chemicals are infused in the solution from which the rayon fibers are spun and cloth woven from these strands has the desirable properties of being both white and "sunproof."

SETS BALLOON LIMIT AT TWENTY-MILE HEIGHT

TWENTY MILES above the earth is the practical limit to which present-day balloons can rise, according to Dr. Jean Piccard, famous balloonist now planning a new flight into the stratosphere. Using a bag large enough to hold sufficient gas to rise to greater heights, the strain on any known balloon fabric would pass its breaking point, Dr. Piccard explained.

Pranks of Vibration Create New Problems

(Continued from page 19)

springs and loose shock absorbers met this queer trouble on many of the earlier concrete roads Highway engineers have learned that it can be avoided by spacing the expansion joints at unequal distances.

Automobile vibrations often have come in unusual disguises. Thousands of drivers have been annoyed by the shimmying of front wheels, but probably few recognized it as vibration. Most of them would be astounded to know that the shimmying involved almost the same principle as the flutter of airplane wings. The energy that made the wheels shimmy came from peculiarities of their alignment; it was conserved and built up by the resilience of tires and steering assembly. The inexpert motorist, by his efforts to check the bouncing from side to side, often actually added his own energy to it.

Manufacturers wiped out the source of crankshaft-vibration troubles by "dynamic balancing." Intricate precision instruments were developed to make possible the delicate balancing of the shafts while they were rotating.

Leading builders of heavy machinery have used such dynamic balancing for a number of years, so serious unbalance now is relatively rare. But there are other, even stranger causes of vibration.

In a certain district of a large eastern city, occupants of a number of houses began to be annoyed by an unusual sound. The houses themselves were humming!

THE trouble was traced to a power station several blocks away, where a group of single-phase, alternating-current generators were operating. Each time the current changed, there was an almost infinitesimal period of "slack" in the strain on the generators. Those lulls, coming at the rate of 120 a second, caused a vibration that traveled unnoticed through the foundation and all the way to the houses that happened to vibrate in resonance with it. Other, nearer buildings failed to "tune in" because of different materials, sizes, or methods of construction.

To quiet the humming houses, engineers mounted the generators on springs. The springs, of course, were capable of vibration but not in harmony with 120 impulses a second. Similar arrangements are often used for isolating the motors on electric refrigerators.

Builders of disk-type turbines, sometimes, actually follow the astonishing procedure of weakening a steel disk to prevent its breaking. In the earlier machines, the huge disks often cracked mysteriously, as if pieces had been chipped out by sledge hammers. Engineers traced the trouble to vibration.

When a metal disk is struck, the vibration goes all the way around it in ripples, just as if the circumference were "flapping." A jet of steam in a turbine starts such a ripple. If the ripple happens to travel in one direction at the same speed the disk is revolving in the other, it results in a "standing wave." The wave can't get away from the steam jet, right at its heels, whipping it harder and harder, until the disk cracks.

To avoid that accident, builders now test each disk with electromagnets which jar it at increasing frequencies until they disclose the exact speed at which the waves travel. If it is within ten percent of the speed at which the turbine is to be run, they change the speed of the waves—usually by making the disk thinner! The slight loss of strength is more than offset by escape from resonance.

Builders of blade-type turbines take equal precautions. In a turbine whirling at the terrific speed of 2,000 or 3,000 revolutions a minute, the snapping off of one blade is likely to cause what German engineers call "blade salad." It means a repair job which may cost over $100,000.

Not only the winglike flutter of blades, but also the resonance must be reckoned with. And it may come from curious sources. In a cargo ship, a few years ago, gear teeth meshing at the rate of more than 100,000 a minute, caused a vibration which "backed up" to a turbine, harmonized with the flutter of the blades, and ripped them off.

Naval architects and engineers face countless difficulties from vibration. It may come from machinery, from propellers, or from the passage of the boat through the water. Resonance of the hull, or of some internal part, may carry it with magnified effect to far-distant sections of the ship.

IN ONE case, actual measurements showed that a vibration of only seventy-five hundred-thousandths of an inch on the frame of a slightly unbalanced turbine was increased more than five times, to four-thousandths of an inch, in one of the upper staterooms. The tremors, coming at the rate of nearly 3,000 a minute, were too fast to be heard, but were "felt" unpleasantly on the eardrums. The largest modern ocean liners have been subject to vibrations which caused serious annoyance to passengers. Engineers sometimes have spent months searching for the causes.

On older ships, vibration often was the unsuspected source of trouble. Some authorities now believe that more than three fourths of the steamers of the past suffered from it, and that it was often responsible for the loosening of hull plates.

On a modern tanker, making its first round trip between New York and New Orleans, it was discovered that the propeller nuts were being mysteriously loosened. Experts found this was due to torsional vibration of the driving shaft.

The curious ability of shafts and similar parts to vibrate torsionally, that is, with a twisting motion, causes many difficulties at sea, on land, and in the air. The movement is similar to that of a twisted string from which a weight is suspended. It turns first in one direction, and then the other. Often the twisting of a shaft, unnoticed, reaches dangerous proportions.

Engineers take special precautions when Diesel or other internal-combustion engines supply the power. When the motor runs at a speed which puts the cylinder firing in resonance with the shaft's torsional vibration, something is likely to break.

That is just what happened on an early voyage of the dirigible *Graf Zeppelin.* At the critical speed, a crankshaft snapped. Before the speed could be changed, three of the four other shafts broke. All had been machined to the same specifications and vibrated at nearly the same frequency. The airship reached its home port with one motor running.

Engineers today control torsional vibration by many clever devices. The frequency is changed, if necessary, and resonance is destroyed by the springlike action of "flexible" shafts or couplings, or by adding special flywheels which change the shafts' weight. Sometimes a flywheel is attached by an ingenious adjustable clutch which "damps out" the vibration almost completely. The clutch grips tightly enough to hold fast while the shaft is under ordinary power. But when the extra twist comes, it slips and acts as a brake.

When engineers face a serious vibration problem, their first task often is to discover the source of the impulses. The clew usually is found in the frequency of vibration. Fascinating but simple instruments have been devised to measure it.

Simple forms of vibration often are timed by a metal reed, used as a sort of tuning fork. Held against the vibrating object, the reed is shortened or lengthened by adjustable screws, until it begins to sway in resonance with the vibration. Calibrated marks show the frequency at each adjustment.

A neon light, flashing at controlled frequency, is often employed to "stop" a moving machine part, and then make it appear to creep forward while its path is studied.

A MORE recent instrument, known as the Davey vibrometer, contains a mirror, reflecting a light beam from a neon lamp. When the device is brought into contact with a vibrating object, the mirror quavers, moving the beam back and forth along an enlarged scale. By regulating the flashing of the neon light, engineers can "stop" it anywhere within its swing, so they can tell not only the speed of vibration but also the amount of deviation from the normal position at any instant.

In an instrument of another type, a weight suspended freely or on soft springs tends to remain stationary, while the lighter parts of the device respond to vibration. A pointer, attached to one part and pivoting on the other, indicates the movement.

One such instrument is so tiny it can be carried in a man's pocket. Others, much larger, contain mechanisms to record the vibration on moving tapes just as seismographs, by exactly the same principle, record earthquakes.

A machine's vibration, in fact, often amounts to a little earthquake. Though not so far reaching as the terrestrial kind, within its limits, it can be equally destructive.

"Gritless" Spinach Is Free from Sand

SPINACH and sand do not necessarily go together, says Maj. Harry L. Bateson, California plant wizard, seen here displaying a sample of the "gritless" variety of the vegetable he has developed after many years of research.

An Honest Survey of Car Owners Revealed this:

Mobiloil Lasts Longer... keeps Engines Cleaner... Cuts Repair Bills!

Harry Windle
Brockton, Mass.
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"You ought to hear how sweet my Ford runs after 10,000 miles on Mobiloil!"

Ludwig Best
Garden City, L. I.
AERO MECHANIC

"I often drive beyond an oil change. Only Mobiloil will stay in my motor."

Mrs. J. Hehn, Jr.
Port Washington, L. I.
HOUSEWIFE

"I've kept track on my old car. I save $4.70 every 1,000 miles with Mobiloil."

W. H. Hanna
Cleveland, Ohio
BOOK STORE PROP.

"Mobiloil gives us full 1,000 miles. A big saving, as I drive 35,000 miles a year."

E. T. Sadler
Chicago, Ill.
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"In 75,000 miles, I've learned Mobiloil is best. It saves me $30 a year."

J. McManus
Haverhill, Mass.
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WE ARE PASSING ON to you voluntary reports from 26 Mobiloil users.

We could explain how Mobiloil is made a *better* oil by the famous Clearosol Process ...why it is cleaner, purer, lasts longer, stands up better.

But the real proof is right here...in the *actual savings* reported by people who *watched costs.*

Summer's here...start saving today with Mobiloil! Stop in at the Mobiloil sign or the Sign of the Flying Red Horse.

SOCONY-VACUUM OIL COMPANY, INC.

Lester A. Jeffery
Detroit, Mich.
RADIO TECHNICIAN

"For 8 years I have averaged 1,200 miles to each filling of Mobiloil. No repairs."

J. R. Jenkins
Albany, N.Y.
HOUSE INSULATOR

"Used Mobiloil for 10 years. My cars always run fine—low oil consumption."

Fred J. Hines
Rochester, N.Y.
GENERAL CONTRACTOR

"By actual test on our equipment, Mobiloil cut our oil costs 23%."

T. F. McNaugh
Cleveland, Ohio
TUGBOAT CAPTAIN

"I sure hand it to Mobiloil. Makes my car smoother—gives it more power."

S. Umina
Cleveland, Ohio
BARBER

"I used to add a quart every 150 miles. With Mobiloil, I don't. Means $25 a year to me."

G. Whitehurst
Waterford, N.Y.
NURSERY MANAGER

"Long trips, fast driving; Mobiloil stands up swell."

F. M. Lansing
Los Angeles, Cal.
MECHANIC

"I can spot the Mobiloil users. The pistons, rings and rods are cleaner."

Capt. F. Hornke
Roosevelt Field, L. I.
FLYING INSTRUCTOR

"I've used Mobiloil here and in Germany for 20 years. Best I've found."

Grace Droney
Boston, Mass.
BEAUTICIAN

"Mobiloil has cut my oil bill between 30% and 35% ... kept engine free of carbon."

Raymond A. Ely
Rochester, N.Y.
ENGINEER

"I drive 1,500 miles a week on Mobiloil. I never add a drop between changes."

Mrs. G. Zapf
Rochester, N.Y.
HOUSEWIFE

"I watched my mileage. I *know* Mobiloil goes farther."

Joseph Pytko
Wynantskill, N.Y.
GARAGE MANAGER

"After 5 years on Mobiloil, my motor runs like the day I bought it!"

A. E. Mosier
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"In 40 years of selling and operating machinery of all kinds, I've never found anything Mobiloil's equal."

W. H. Monrian
Albany, N.Y.
SALES SUPERVISOR

"25,000 miles a year—and never had to add Mobiloil between changes!"

Joe Bova, Jr.
Cleveland, Ohio
GROCERY STORE PROP.

"Your Mobiloil has sure delivered extra mileage in our delivery trucks."

Don C. Lynn
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"In the Imperial Valley, it hits 120° . . . yet Mobiloil keeps my truck engines cool, cutting oil bills 30%!"

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Boston, Mass.
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"I've checked with hundreds of salesmen, who agree—Mobiloil keeps motors at their top!"

Territ E. Swart
Chicago, Ill.
ACCOUNTANT

"I changed to Mobiloil after just one trial. Sure makes a difference."

Robt. H. Glenn
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PHOTOGRAPHER

"3 years on Mobiloil; engine O.K. No repairs."

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UNDER THE BIG TOP. Watching Miss Dorothy Herbert of Ringling Bros.-Barnum & Bailey, you marvel at her poise. Miss Herbert says: "I'm a devoted Camel smoker. Smoke all I want—eat anything I care for. Camels make food taste better and digest easier. And have a royal flavor!"

STOP PRESS! A day's action is crowded into minutes as the reporter works to beat the deadline. "It's a life of hurry, hurry, hurry," says Peter Dahlen, crack newspaper man, "and a life of irregular hours and meals. That's one good reason why I smoke Camels. It's swell the way they make food taste better and set better."

BEHIND THE SCENES IN THE BROWN DERBY. The *chef* is putting the final touches to a Lobster *Thermidor*, while within the restaurant proper the glittering stars of Hollywood gather to chat...to dine...and to enjoy Camels. Here, the mildness and flavor of their costlier tobaccos have made Camels an outstanding favorite. As Mr. Robert H. Cobb, the man behind The Brown Derby's success and host to the great personalities of Hollywood, remarks: "Camels are the choice of the majority of our patrons."

for Digestion's sake ...Smoke Camels

Smoking Camels stimulates the natural flow of digestive fluids...increases alkalinity

Life sometimes pushes us so hard that we feel too worn-down really to *enjoy* eating. Science explains that hurry and mental strain reduce the flow of the digestive fluids.

Evidence shows that smoking Camels increases the flow of digestive fluids... alkaline digestive fluids... so vital to the *enjoyment* of food and to *good digestion*.

Camel's rich and costly tobaccos are mild beyond words. Enjoy Camels steadily. Camels set you right! And never jangle your nerves or tire your taste.

Camels are made from finer, MORE EXPENSIVE TOBACCOS...Turkish and Domestic...than any other popular brand.

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